MINING CONGRESS JOURNAL

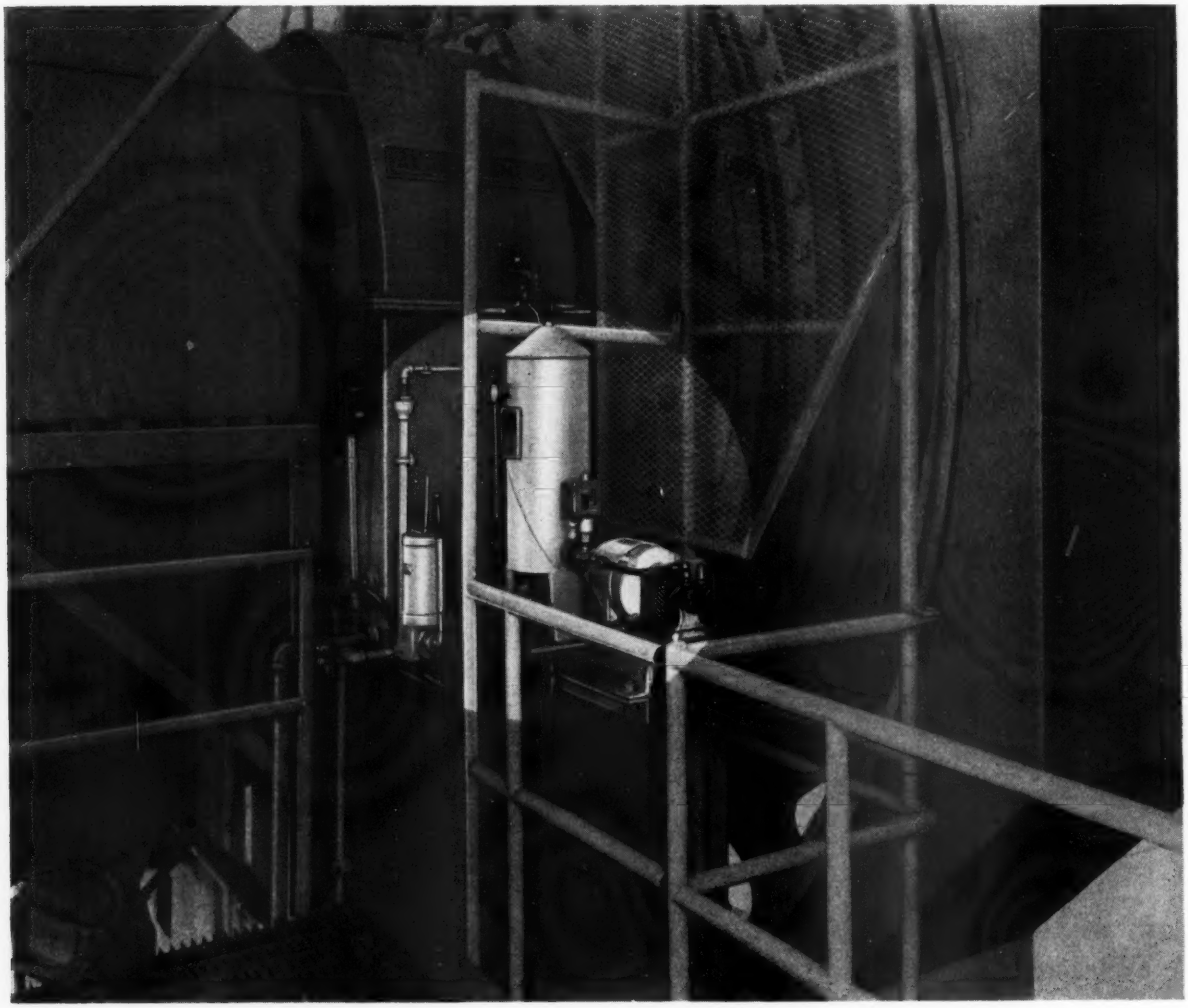
APRIL 1960

1960 AMC COAL CONVENTION, PITTSBURGH, PA., MAY 9-11

See Story and Program Pages 34 to 43

ALLIS-CHALMERS

A-1269



Floating start, ride and stop for big mills

New Lubritrol system provides constant lubrication for trunnion bearings

The new, bigger A-C grinding mills actually *float on oil.* Process industries are grinding out bigger profits because of *Lubritrol* constant lubrication system. No bearing-wearing starts. No dry sliding after shutdown. Less wasted horsepower. All functions of the *Lubritrol* system are automatic...controlled by foolproof pressure gauges and switches. The system is filtered to remove contaminants.

When you modernize your operation, check the benefits of an Allis-Chalmers grinding mill — the only mill that gives you the positive protection, the operating and maintenance economy of *Lubritrol* constant lubrication. *See your A-C representative, or write* **Allis-Chalmers,** *Industrial Equipment Division, Milwaukee 1, Wisconsin. In Canada, write Canadian Allis-Chalmers Ltd., Box 37, Montreal, Quebec.*

Lubritrol is an Allis-Chalmers trademark.

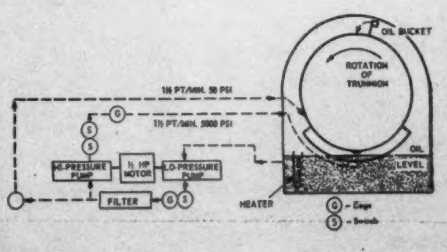


Diagram of LUBRITROL System

MINING CONGRESS JOURNAL

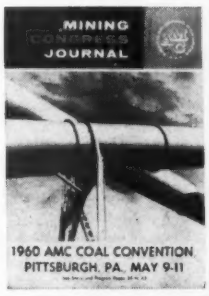
VOL. 46 APRIL 1960 NO. 4

CONTENTS

Opinions expressed by the authors within these pages are their own and do not necessarily represent those of the American Mining Congress.

ON OUR COVER

Conveyor belts are enclosed in pipe at U. S. Steel Corporation's newest coal preparation plant. This and other interesting innovations at the Maple Creek plant may be studied first hand by mining men attending the 1960 AMC Coal Convention. For more information on this special tour, read the convention preview beginning on page 34.



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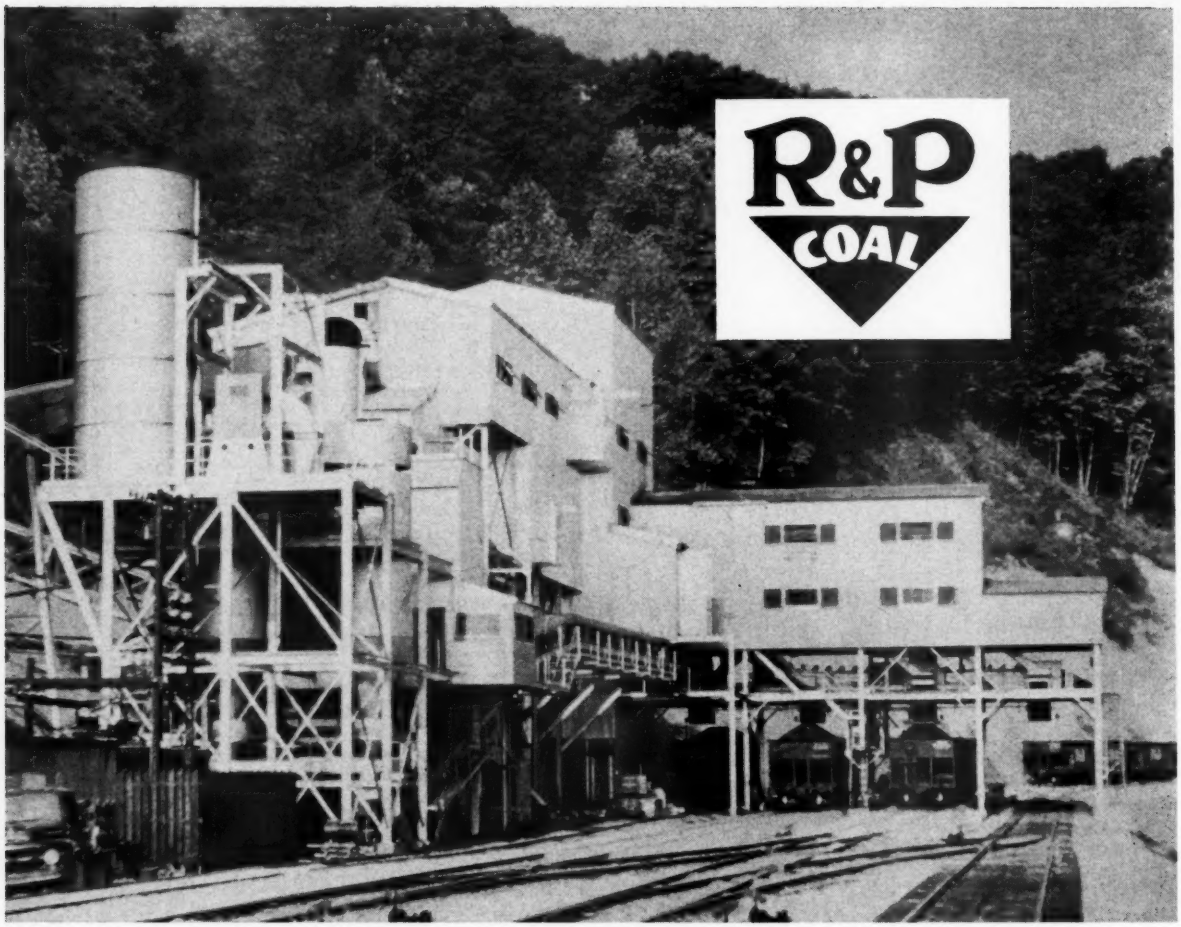


Rochester & Pittsburgh Coal Company's O'Donnell Mine No. 2
Preparation and Thermal Drying Plant for 400 TPH of 5" x 0 Coal.
3 Compartment—8 Cell Air Operated Jig, H & P Cyclones,
Reineveld Fine Coal Dryers,
Vacuum-Filter and H & P Fluid Bed Dryer.

GOOD, CLEAN COAL FROM R&P COAL COMPANY

The new Coal Preparation Plant at O'Donnell Mine No. 2 is operating satisfactorily after an exceptionally short breaking-in period. Good results and smooth operating conditions were expected by Rochester & Pittsburgh Coal Company's management when they decided to install many of the products of Heyl & Patterson's research program for advanced coal preparation machinery and processes.

The Rochester & Pittsburgh Coal Company says:

"The flexibility built into this plant is already paying off. Even with fluctuating feed conditions, the product is low in ash and moisture. As a result, unexpected marketing opportunities have opened up."

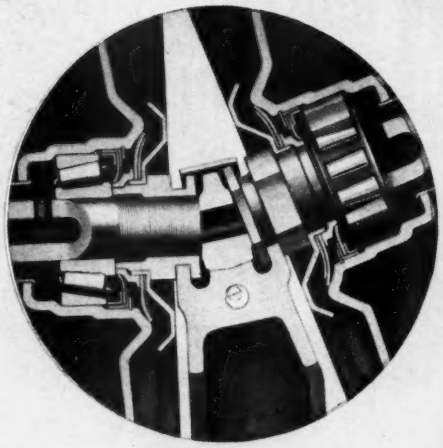
Discuss your new coal preparation requirements with H & P engineers whose experience is at your disposal to conceive a preparation plant best suited to your own operating and marketing conditions.

Whether you require a turn-key job or prefer a cooperative effort—remember:

When Experience Counts... Count on Heyl & Patterson

HEYL & PATTERSON inc.

55 FORT PITT BLVD., PITTSBURGH 22, PA. • COurt 1-0750



How **THE JEFFREY MFG. CO.** mounts Timken bearings in their Permaseal® idlers to maintain prelubrication and positive sealing, reduce maintenance.

Conveyor belt moves materials at less cost with Timken® bearings rolling the load

THIS huge conveyor belt does a whale of a job moving materials speedily and economically at these ore docks in Philadelphia. And to keep 'em rolling at lowest cost, the conveyor belt is supported by Jeffrey Permaseal® idlers with Timken® tapered roller bearings. This type of conveyor handles ore, coal, lime, over-burden, salt and gypsum. Timken bearings on these applications assure minimum maintenance, long bearing life because:

1) *They hold shafts concentric with housings,* making idler seals more effective in keeping dirt out, lubricant in.

2) *The tapered construction* of Timken bearings lets them take radial and thrust loads in *any* combination.

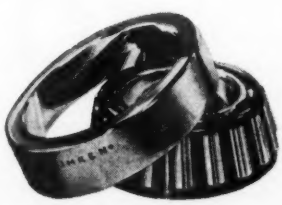
3) *Full line contact* between rollers and races gives Timken bearings *extra* load-carrying capacity.

4) *And Timken bearings are made of the finest bearing-quality alloy steel available.*

The Timken bearing is the only tapered roller bearing proved by 40 years of service in heavy-duty conveyors using the popular dead shaft construction. For better performance at lower cost, be sure the machines you buy or build are equipped with Timken tapered roller bearings.

When you buy Timken bearings you get ...1) Quality you can take for granted. 2) Service you can't get anywhere else. 3) The best-known name in bearings. 4) Pace setter in lower bearing costs.

The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO". *Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.*

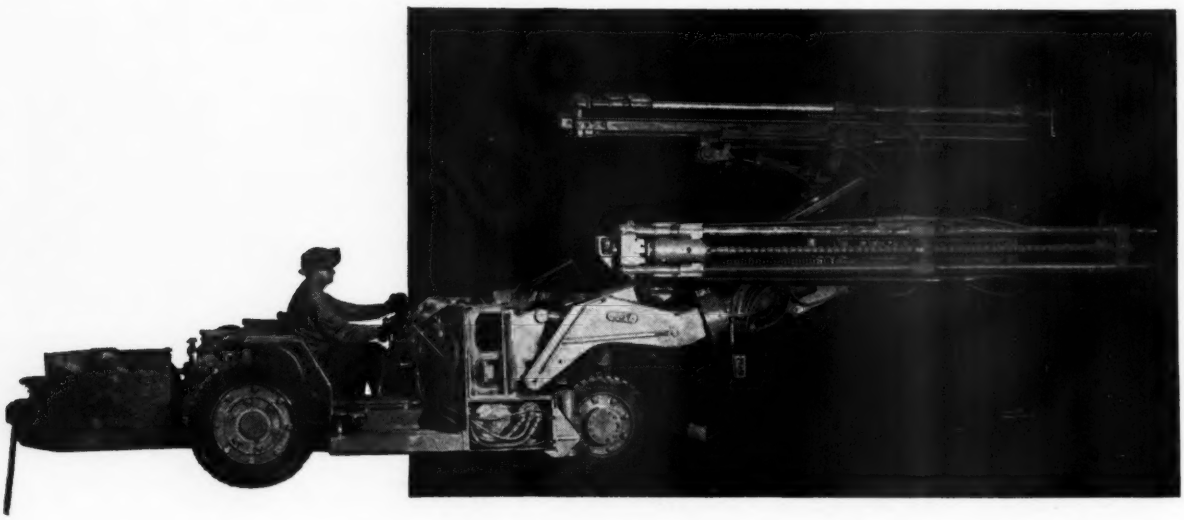


BETTER-NESS rolls on

TIMKEN®

tapered roller bearings

ONE OPERATOR... TWO DRILLS...
12 FT. HOLES IN ONE MINUTE WITH THE
NEW JOY CD-43



The newest Joy coal drill has two drills, but requires just one operator. And he never has to leave the control console at his seat.

The operator spots a hole by locking pick-points against the face, then starts drilling. While the drill penetrates to blasting depth, he positions the second unit, and starts *it* drilling. Convenient controls give him hydraulically powered mastery over all movements of the machine—positioning, drilling and tramming.

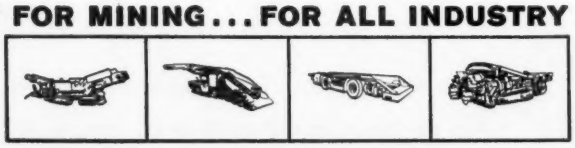
The basic drilling unit of the machine is the time-proved Joy CD-40 hydraulic auger drill. Simple and rugged, this drill is fast—a hydraulic thrust of 1500-1800 lbs drills coal at speeds up to 12 feet per minute. Ten or twelve foot feed eliminates stopping for auger changes. The auger is one piece, machined from solid bar stock, and heat-treated for long life.

For high seam or medium-high seam operation, the CD-43 reaches from 4″ to 10′6″ from the bottom, and reaches 21′ horizontally across the face without moving the machine.

The result—faster rounds with a much faster drilling cycle to keep up with other high-speed equipment. Ask your Joy engineer all about the one-man CD-43.

See You in PITTSBURGH at the American Mining Congress COAL CONVENTION May 8-11, 1960

EQUIPMENT FOR MINING... FOR ALL INDUSTRY

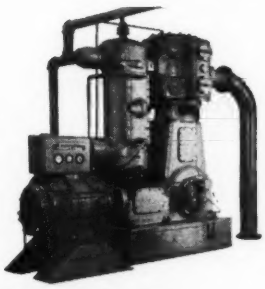


JOY

Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.

In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario

Which... ATLAS COPCO COMPRESSOR meets your needs best?



AR Heavy-Duty Compressors
More air per horsepower than any comparable compressor! For continuous, full-load operation. "L" angle, 2-stage, double acting. Water cooled. Standard models provide 382 to 3210 cfm free-air delivery at 100 psi; only 76-590 hp required! (Can be supplied for other working pressures on request.)

What's your compressor requirement? Need an installation large enough to provide air for all your needs? Or would a small, compact unit for auxiliary operation solve your immediate problem? Either way—and for a wide range of applications between these extremes—Atlas Copco has the compressor for you!

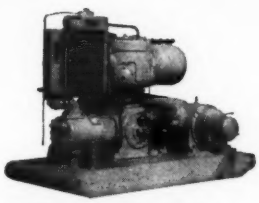
No matter which you choose, you'll get these proven advantages from Atlas Copco:

(1) More air per horsepower—less power consumption than other comparable units!

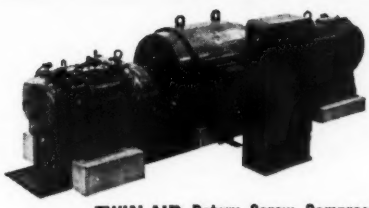
(2) Really low maintenance (one example — $3.10 after 10,000 hours' operation)!

(3) Specifications are guaranteed free-air delivery — you get exactly what you order!

Get all the facts now—and compare! The coupon below will bring you a free catalog. (No obligation, of course.)

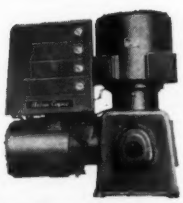


AR-L Heavy-Duty Compressors
Same basic construction as the AR Series, but provided with an air-cooled intercooler and air-cooled radiator for the cylinder water. Fan on compressor flywheel cools radiators. Perfect for arid areas or where difficult to bring in water. Both stationary and skid-mounted models available.



TWIN-AIR Rotary Screw Compressors
Brand new! "Twin-Air" Compressors offer capacities from 6,900 to 19,400 cfm at working pressures up to 115 psi. And, you get completely *oil-free* delivery of air or gas, since no lubrication is required — timing gears maintain small clearances between precision-mounted rotors, eliminating friction (and the necessity of oil) in compression chamber.

CT Air-Cooled Compressors
Stationary, or skid-mounted compressors for use where air demand is between 50 and 300 cfm. Totally air-cooled. Cylinder arrangement designed for smooth, vibration-free operation. Compact, rugged—for continuous, 24-hour trouble-free service. Highly efficient; low on maintenance costs.



ER-6 Heavy-Duty Compressors
New! Fundamental improvements over conventional heavy-duty compressors reduce power requirements (18.3 hp/100 cfm at 100 psi, full load); provide totally enclosed design; and save on floor space. Capacities to 1,140 cfm; standard instruments and safety devices.

ATLAS COPCO
Dept. MCJ-5, 545 Fifth Avenue,
New York 17, N.Y.

Gentlemen:
Please send me ☐ Short-form catalog ☐ Detailed information on the_____Series

Name_____ Title_____

Firm_____

Address_____

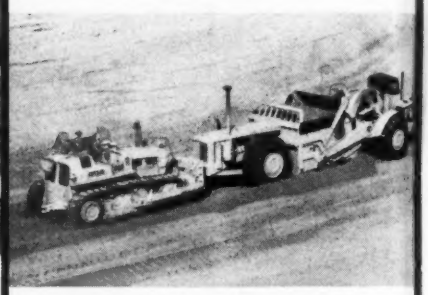
City_____ Zone_____ State_____

Atlas Copco

610 Industrial Avenue
Paramus, New Jersey
COlfax 1-6800

930 Brittan Avenue
San Carlos, California
LYtell 1-0375

At a coal stripping operation in Pennsylvania, this TC-12 removes overburden at a rate of 400 to 500 yds. per hour. It is equipped with 16' blade...works two 8 hr. shifts a day.



Euclid Twin-Power teams — TC-12 Crawlers and TS-24 Scrapers — move over a million yds. a month at this Wyoming open pit uranium operation.

Model C-6 crawler back-filling overburden in the pit . . . full-power shift, good visibility and fast response make this "Euc" a high production machine for mine and quarry work.

Work-ability of "EUC" Crawlers Steps Up Production on Tough Stripping Jobs

Euclid's modern crawlers—the 211 net h.p. Model C-6 and the Twin-Power Model TC-12 with 425 total net h.p.—have set new standards of tractor production in mine and quarry work. With performance proved Torqmatic Drive, both of these crawlers have excellent maneuverability and fast response that cuts work cycle time. They're engineered for easy service accessibility that results in less downtime and lost production.

Have your dealer give you all the facts on these "Euc" tractors...he'll show you the features that pay off in better production on every stripping job, whether it's heavy dozing or ripping work, push loading big scrapers, or moving coal, ore and other materials.

EUCLID Division of General Motors
Cleveland 17, Ohio

Plants at Cleveland and Hudson, Ohio, and Lanarkshire, Scotland.

GM GENERAL MOTORS EUCLID

EUCLID EQUIPMENT

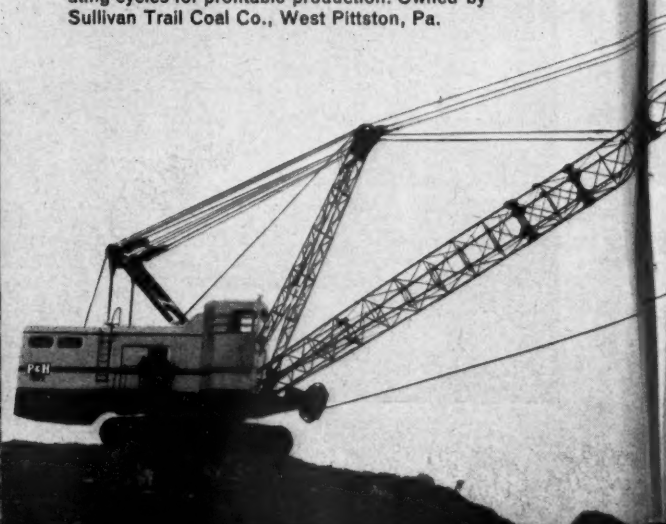
FOR MOVING EARTH, ROCK, COAL AND ORE

8-yard P&H 1855 Stripper Shovel combines long reach with mobility and fast operating cycles.

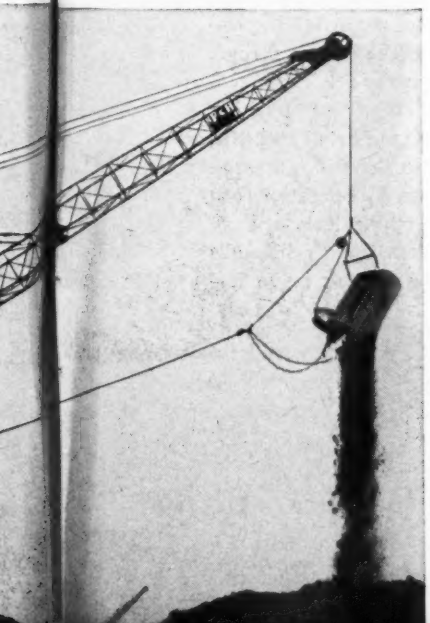
MAGNETORQUE® drive puts more material into the dipper—faster

In Bituminous Coal—P&H 1855 Stripper Shovel puts more material in the dipper faster on every pass. Owned by Tri-State Corp., Steubenville, Ohio.

In Anthracite Coal—P&H 1855 Dragline combines long boom, large bucket and fast operating cycles for profitable production. Owned by Sullivan Trail Coal Co., West Pittston, Pa.



with every pass



Because of Magnetorque Drive

P&H 1855 GETS UP TO 25% FASTER OPERATING CYCLES...

...outproduces any stripper shovel in its class

Prime reason for the faster stripping ability of the 1855 is Magnetorque drive—the most productive work-motion drive known for electric mining excavators. This advanced P&H drive electro-magnetically transmits the full power of an A.C. motor direct to hoist, swing and propel motions—without motor generator set conversion to D.C.

Results: Up to 30% higher bail pull, more uniform dipper speed in the bank with faster swing motion—important factors which produce up to 25% faster, well balanced operating cycles.

The 1855 is rated up to 8 cubic yards as a stripper shovel, with a choice of boom lengths up to 70 ft. and dipper handle lengths up to 56 ft.—all fabricated of ultra-high-strength T-1 steel. The machine is also fully convertible for long range dragline service. Unmatched for maneuverability, it is the largest excavator mounted on a single pair of crawlers.

The shovel crowd of this giant electric develops enormous thrusting power with rapid response, for it is powered by a D.C. motor driving the exclusive P&H multiple-thread hour-glass worm mechanism.

Harnischfeger is the only shovel manufacturer which makes its own electrical as well as mechanical components—all matched to work together and *designed specifically for electric shovel service.* Write Dept. 618A, Harnischfeger Corporation, Milwaukee 46, Wis.

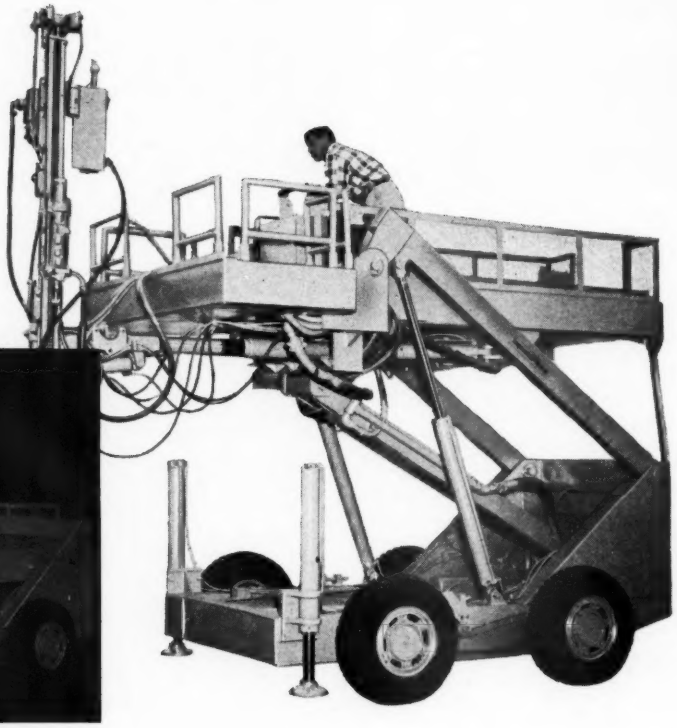
HARNISCHFEGER
Milwaukee 46, Wisconsin

P&H
CONSTRUCTION & MINING DIVISION

MECHANIZED ROOF-BOLTING

RIGHT—I-R Roof-Bolting Jumbo with elevator raised to upper position for working in a 14-foot seam.

BELOW—same jumbo, with elevator lowered, is right height for an 8-foot seam.



Special I-R ROOF BOLTING JUMBO drills, drives, and tightens bolts in 8 to 14-ft seams

Ingersoll-Rand rock drill engineers have come up with a unique solution to a troublesome roof-bolting problem on a job where with conventional stopers and temporary stagings, roof-bolting crews were hard pressed to keep ahead of drilling operations in a room-and-pillar mining system. Drillers often had to wait for roof bolts to be set before they could move in on a new face. Now a two-man crew easily keeps ahead of all drilling operations.

Each self-propelled jumbo consists of an elevator platform which carries a Hydra-Boom-mounted vertical drill feed with DB-30 drifter and Torque Control Impactool.

In operation, the jumbo is propelled into approximate drilling position by I-R air-motor drives—anchored with hydraulic leveling jacks—and the platform raised by hydraulic cylinders to the desired height. The drill is spotted in position by the Hydra-Boom and the hole is drilled. The drifter is then run down the feed, the steel removed and the Impactool swung into position above the drill. The roof bolt is inserted and drill feed raises the wrench into position for tightening the bolt to the required torque. All operations are throttle controlled from the upper deck.

If you have a drilling problem, Ingersoll-Rand's specialized experience can help you solve it—quickly and efficiently.

Ingersoll-Rand

5-904 11 Broadway, New York 4, N.Y.

A CONSTANT STANDARD OF QUALITY IN EVERYTHING YOU NEED FOR ROCK DRILLING

engine power
BY CATERPILLAR

FACTS ON REPOWERING WITH CAT ENGINES

Obsolescence has a way of creeping up almost unnoticed on equipment like industrial locomotives. One reason is that you buy equipment like this with long-term use in mind. So long as it performs reasonably well, an industrial locomotive seems ageless.

Yet, age does take its toll in efficiency. The locomotive needs more care and parts. It's slower on round trips. Down time occurs more frequently. It just isn't as reliable as it once was.

In some instances, the job grows beyond the locomotive's capacity. When the job is just slightly bigger than the engine, it's economically hard to warrant the cost of a new unit to get ahead. Many owners of industrial locomotives have found an answer to the age problem that's economically sound and sensible, too, from the production standpoint. They've simply repowered with Caterpillar Diesel Engines. For a modest investment—compared to costly maintenance or to buying a new locomotive—they now have locomotives that perform better than new.

A sand and gravel producer repowered a Plymouth locomotive with a Cat D337 and was able to do away with a steam locomotive he purchased from scrap to keep materials moving. The repowered 45-ton engine, reports the company, can break away and haul greater tonnage than the 60-ton steam locomotive. When the Plymouth had an air-operated clutch (direct drive), it was a major headache . . . big loads were clutching and declutching nightmares. Clutches wore out fast. Engine repairs were high and even the rails wore out rapidly. Efficiency was low.

In another instance, the owner of a 25-ton locomotive crane replaced a gasoline engine with a Caterpillar Diesel. This changeover has proved to be a very practical installation. Power and economy are good. In addition, the simplicity of the installation and the low cost of the changeover were added advantages gained by this owner.

Cat Diesels prove themselves in changeovers from every kind of power—including steam. A 15-ton locomotive crane, powered by steam, was changed to a Cat D315 with Torque Converter. The engine has more than ample power reserve for work—and the power is far smoother than that obtained with steam. The crane's work output shot up 33%—and the cost of diesel fuel is a small fraction of the cost of boiler fuel. And no fireman is needed with the diesel installation.

We could cite an almost endless list of examples. In each case, the equipment owner made the changeover on the basis of careful evaluation of every repowering aspect. In every case, Caterpillar Diesel Engines proved to be the best repowering investment. Post-installation performance justifies the choice down the line. Output goes up. Operating costs go down. Costly maintenance vanishes and dependability rises to new highs. And all of this comes with an investment that's only a fraction of that for purchasing new equipment to replace the entire unit.

When you think of repowering, be sure to have your Caterpillar Dealer give you his recommendations. He probably has repowered locomotives or cranes like yours. He can give you a clear idea of the cost and of the results you can expect. Probably, too, he can show you how to save a good deal of money. He has dependable Caterpillar Diesel Engines from 50 to over 700 HP, in a choice of many configurations. He is able to match the engine and transmission precisely to your need.

Send for "Caterpillar Engines for Railroad Power" and for "Railroad Equipment Manufacturer's Machines Powered by Cat Diesels." Each contains power data that can help you work out the best answer to your engine needs. Send for these today.

CATERPILLAR

Engine Division, Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

Thor

Everything you want in Push Feed Drills . . .

and more!

Thor's new model 330 push feed rock drill outperforms every other drill in its class . . . a fast, rugged, perfectly balanced drill with convenient controls. Two new feed legs have been engineered for use with the Thor model 330.

Model 333 is a power retracted feed leg, single stage, which can extend 51" in operation.

Model 335 is a telescopic, manually retracted leg with a total feed movement of 73".

The feed cylinder of both legs is attached to the drill, so that the feed rod extends from the top of the cylinder when the drill is operated. Either leg is easily attached to the drill by a single nut.

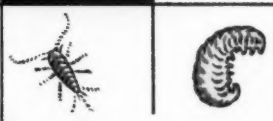
The throttle valve controls the air and water supply to the drill and the feed leg. Ask your Thor "Red Tool" distributor or Thor service branch to demonstrate. Thor Power Tool Company, Aurora, Illinois. Branches in all principal cities.

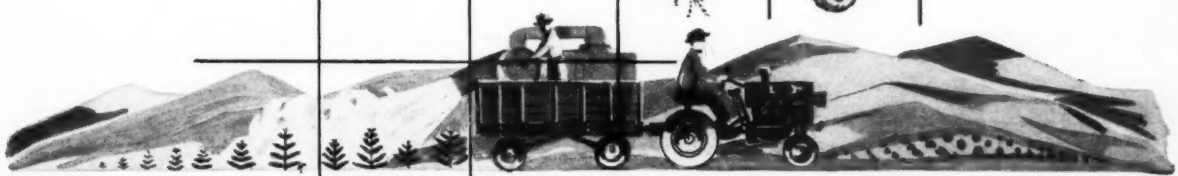
Thor POWER TOOLS

SULPHUR

ONE OF THE FOUR STRONG PILLARS OF PROCESSING

...BUT WHAT A 2% !





A recently compiled breakdown of Sulphur consumption in the United States, shows about 2% of the Sulphur goes into the manufacture of insecticides and fungicides.

Not much, perhaps, as tonnages go but no other use of Sulphur is more important with the possible exception of the 'wonder' drugs. It doesn't take much imagination to picture what would happen if the bugs and parasites were allowed to take over our crops and trees. Sulphur, along with other chemicals, is helping to protect our food supplies and foliage.

The role that TGS is playing in this constant fight against crop destruction is to see to it that the manufacturers of the insecticides and fungicides *always* have a ready supply of Sulphur, both solid and molten. This constant production and centralized distribution coupled with technical help is our contribution to industry.

SULPHUR PRODUCING UNITS

- Newgulf, Texas
- Spindletop, Texas
- Moss Bluff, Texas
- Fannett, Texas
- Worland, Wyoming
- Okotoks, Alberta, Canada

TEXAS GULF SULPHUR CO.

75 East 45th Street, New York 17, N. Y.
811 Rusk Avenue, Houston 2, Texas

There's a reason WHY in WHYte Strand Mining Ropes*

They bring out the best in your mining equipment!

Just as you use specialized equipment for a particular job, it pays to use the right kind of wire rope designed for that equipment.

All wire rope isn't the same. There are changes in the construction of wire rope . . . which aren't obvious to the eye . . . but can seriously affect the way it will work on your equipment. Because all equipment isn't the same, different types of rope are required because of basic design variations.

With this in mind, you can see the reason "why" Macwhyte offers such a wide variety of wire rope:

* Every foot of wire in Whyte Strand is specially drawn, cold-worked by Macwhyte in their own wire mill. Complete processes — from raw material to finished wire for rope — are under the watchful eyes of Macwhyte metallurgists.

* Product engineers determine the exact number, size, and relationship of the wires needed to meet the requirements of your equipment. You're sure of the correct size, strength, and flexibility.

* Special lubrication is available in accordance with the needs of the equipment or the type of service in which the rope will be used. The tenacious lubricants provide just the necessary protection — are unaffected by heat or cold, dry or wet conditions.

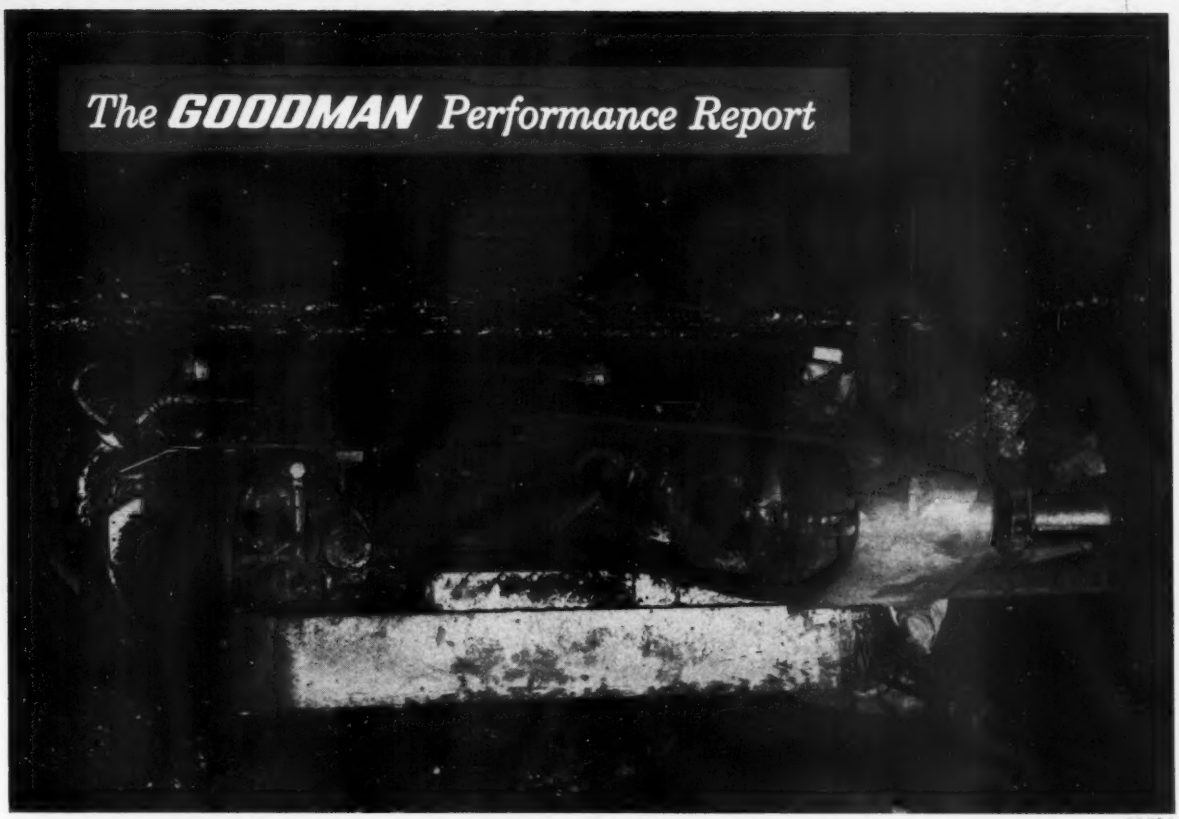
* Entire wire and rope mill operations are concentrated on the making of wire rope in a thousand and one sizes, grades, and types . . . to give you the rope you need.

Result: Whyte Strand wire rope is literally "custom made" for strip shovels, loading shovels, draglines, shaft hoists, haulage, underground scrapers, loaders, mining machines, conveyors, car pullers, and blast hole drills. Ask for new bulletin 6025 giving complete listings of Whyte Strand wire rope.

222

MACWHYTE Wire Rope COMPANY

2900 Fourteenth Avenue, Kenosha, Wisconsin, U. S. A.



22506

How to make development pay off

They moved in—worked 27 consecutive day and night shifts—efficient, 5 man crews and one Goodman 300 Continuous Borer. *All in solid work* in 63″ coal. It paid off! They advanced 5,578 feet (206.5 feet per shift) and mined 16,734 tons (3 tons per foot). This is an average of 619.7 tons per shift and 123.9 tons per shift per man. The borer was serviced by a Goodman loader and two shuttle cars.

22503

The 300 cuts a 13′-10″ wide path at 48″ and a 14′-10″ path at 66″. Bottom is flat for good roadway.

Variation in seam height was no problem because the 300's cutting height can be adjusted while operating . . . full range of adjustment is from 48″ to 66″. Also, as development work reaches planned limits, the maneuverability and capacity of the 300 will be utilized in full production work including pillar recovery.

Let your Goodman Sales Engineer give you the complete story of this full-face mining, continuous borer. Ask him to arrange for you to see it in action.

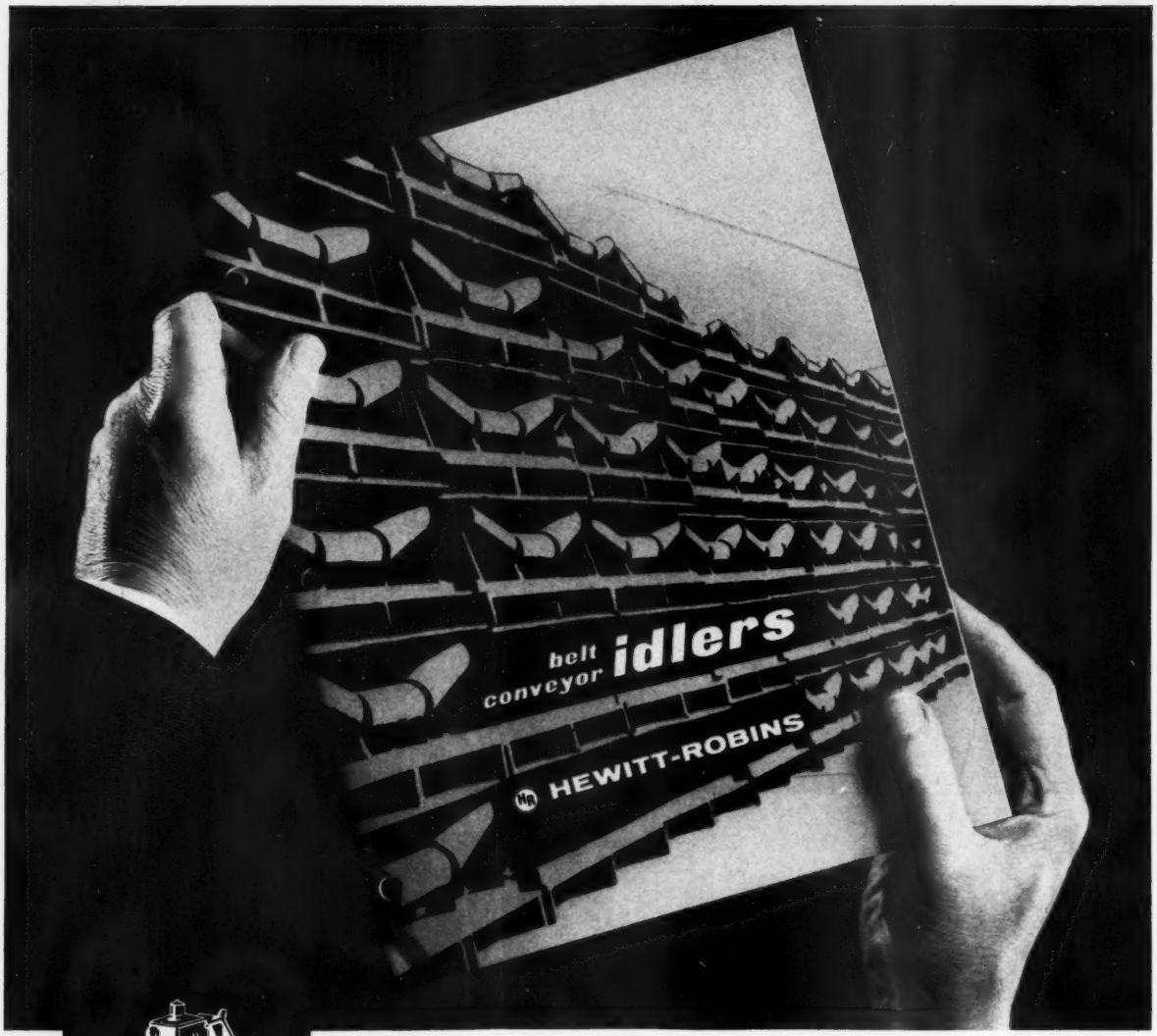
GOODMAN

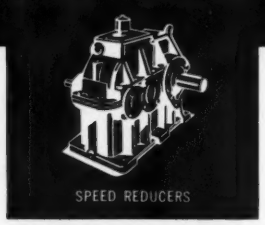
MANUFACTURING COMPANY

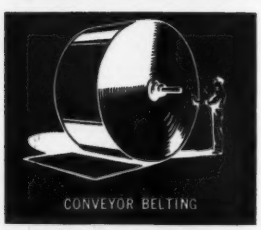
Halsted Street and 48th Place, Chicago 9, Illinois

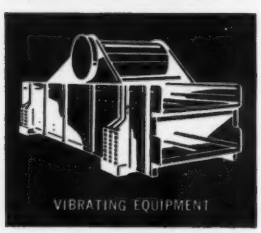
CUTTING MACHINES • CONVEYORS • LOADERS
SHUTTLE CARS • LOCOMOTIVES • CONTINUOUS MINERS

Use Genuine Goodman Replacement Parts




SPEED REDUCERS


CONVEYOR BELTING


VIBRATING EQUIPMENT

Idler questions? H-R has the answers!

At last! A truly comprehensive book on belt conveyor idlers that answers *all* your questions. The new Hewitt-Robins "Belt Conveyor Idlers" book is one of the most complete ever offered to industry. In it you'll find:

- More than 80 helpful graphs, sketches, tables, charts; 150 illustrations; 48 pages of detailed information you can use.
- Comparison of ten competitive idler designs.
- Answers to questions frequently asked about idlers.
- Engineering information on belt speeds, conveyor capacities, idler spacing, and other factors you must consider in selecting idlers.
- Complete explanation of 14 basic types of idlers manufactured by H-R to fit every belt conveyor need.
- Tips on how to extend the life of idlers.

For your copy, consult your H-R representative, or write Hewitt-Robins, Stamford, Connecticut. Ask for Bulletin 4-15.

HEWITT-ROBINS

The name that means everything in bulk materials handling systems...

CONVEYOR BELTING AND IDLERS • INDUSTRIAL HOSE • VIBRATING FEEDERS, SCREENS & SHAKEOUTS • POWER TRANSMISSION EQUIPMENT

DEMONSTRATIONS PROVE CURTISS-WRIGHT SUPERIORITY

CW-226—26 CU. YDS. STRUCK

CWD-221—35 TON CAPACITY

CW-220—20 CU. YDS. STRUCK

CWD-214—25 TON CAPACITY

CW-215—15 CU. YDS. STRUCK

CWD-321—35 TON CAPACITY

CW-28—8.2 CU. YDS. STRUCK

CWT-30—30 CU. YDS. STRUCK

CW-320—20 CU. YDS. STRUCK

CWT-8—8 CU. YDS. STRUCK

A

Greater Bowl Factors— Faster Cycles Give Top Profit Per Equipment Dollar

You know that the machine that moves the most dirt makes you the most money — but, how do you select that machine? By past experience? No, because constantly changing models, techniques and contract conditions make this method impractical . . . By appearances? No again! You wouldn't bid a job on surface appearances alone, so why risk your profits by buying a scraper by the same method.

This leaves only one practical solution to the problem of buying a scraper. That is actual performance evaluation in the field, with a decision based on load weights, bowl factors, cycle times and the many other points that add up to high production. As one contractor says: "We considered three other major makes of scrapers for the job, but comparison and field demonstrations proved Curtiss-Wright the best machine. We feel that the added production and high bowl factors will save several cents per yard for any contractor, as it has for us."

Savings such as this are the result of buying by proven performance. See these results for yourself with a Curtiss-Wright demonstration on your job.

A C-W MODEL FOR EVERY APPLICATION

Five self-propelled scrapers with capacities from 8 to 26 cu. yds. struck, up to 36 cu. yds. heaped . . . Three interchangeable rear dumpers with 25 and 35 ton capacities . . . Six tractor-drawn scrapers with capacities from 8 to 30 cu. yds. struck, up to 39 cu. yds. heaped . . . A total of 14 high-performance machines covering the complete range of practical earthmoving applications.

SOUTH BEND DIVISION

CURTISS-WRIGHT

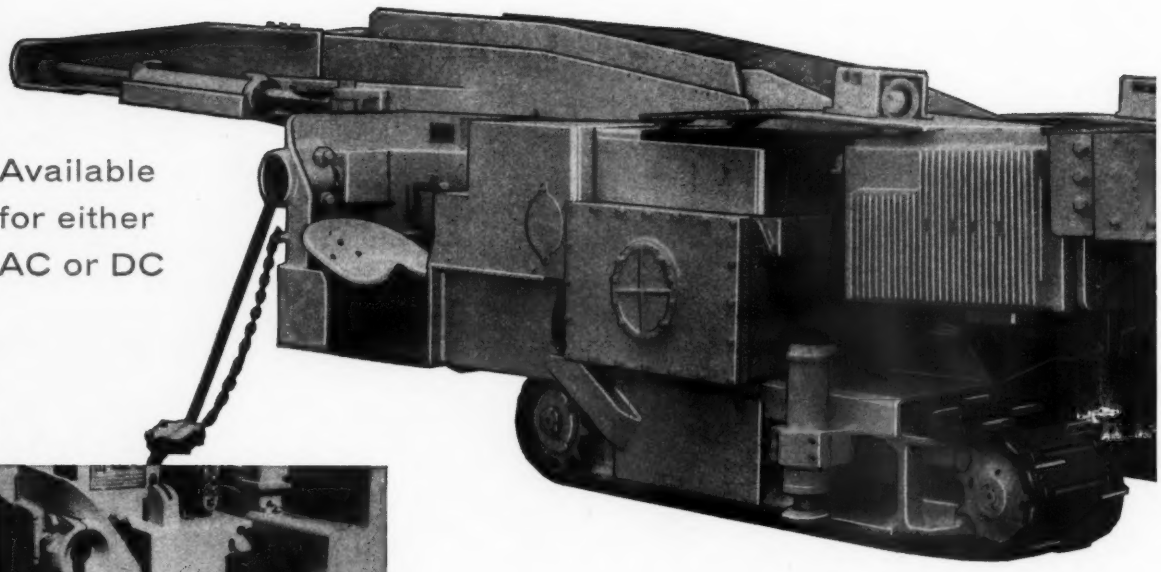
CORPORATION

SOUTH BEND, INDIANA

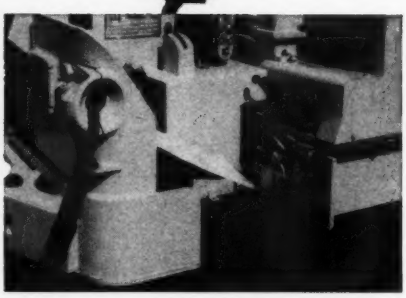
Distributed in Canada by Canadian Curtiss-Wright Ltd.

Ad No. 5277

LIGHTWEIGHT COST *plus* HEAVYWEIGHT *equals* PRODUCTION



Available for either AC or DC



OPERATOR'S PLATFORM

Compact and convenient hydraulic and electrical controls are within easy reach of the operator. Throttle valve precisely controls the speed of all hydraulic operations as well as providing "deadman" control.

16″ WIDE CRAWLER

The new crawler with heavy-duty gearing can operate the miner on steep grades and also float on soft bottom.

Less than 25 P.S.I. ground pressure.

GATHERING HEAD

The exclusive "dual gathering arms" provide maximum reach and much better flow to the conveyor.

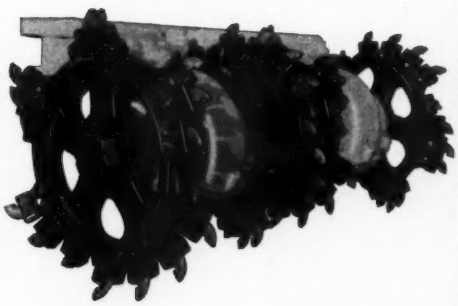
PERFORMANCE PUNCH

Lee-Norse CM38 and CM48 MINERS

29 TONS with power-smooth cutter-action that cuts 42" to 120" seams and gathers loads as fast as they are cut

CUTTING HEADS

New "Rap-Lok*" Cutter Bits, spaced evenly around cutter rim, provides smooth, vibrationless performance. Extremely quick "bit change"—no set screws—long bit life.



*Trade Mark of The Cincinnati Mine Machinery Co.

Lee-Norse Company

CHARLEROI, PENNA.

Specialists in Coal Mining Equipment

Coal high or low?... Lee-Norse MINERS keep production on the go!

Pass the salt...

from 2,000 feet below Lake Erie

...a job for USS Tiger Brand

Fairport Harbor Mine of the Morton Salt Company showing skip hoist at left and processing plant at right.

Rock salt discharges from the skip into a hopper and then flows on to a conveyor leading to the processing plant.

Skip hoist equipped with two Tiger Brand wire ropes. Two skips operate simultaneously—one discharges at the top while the other loads at the bottom.

The deepest salt mine in the United States is located at Fairport Harbor, Ohio, about 25 miles northeast of Cleveland. It taps a vast bed of salt 2,000 feet below the surface and extending far under Lake Erie. This is the first mine of its kind built in this country in the last 25 years. The shaft is deeper than the height of the Empire State Building.

Geologists estimate that the high-grade rock salt in this location will last over 200 years. The Morton Salt Company of Chicago, developers of the mine, aim to produce about 500 tons of salt an hour. All of it will be used for industries in the East and Midwest and for spreading on highways and sidewalks in winter.

USS Tiger Brand Wire Rope forms the vital connecting link between the salt bed and the surface. Two huge skips, shaped like rockets, have a capacity of 16 tons each and make 31 trips per hour. They are hoisted at a rate of 1,380 feet per minute by two Tiger Brand $2\frac{1}{8}$" dia. Special Mine Hoist Ropes 2,580 feet long. These ropes provide the strength, fatigue and abrasion resistance necessary for safe and economical service. To prevent corrosion from the salt, the ropes are thoroughly lubricated at the factory and are relubricated every month at the mine.

Why USS Tiger Brand is your best buy. Tiger Brand Wire Rope is designed by one of the industry's most capable staffs of wire rope engineers. It is made by a company that maintains the most complete research and manufacturing facilities in the steel industry. When you buy Tiger Brand you get the right rope for the job. And your installation is no further away than a phone call from experienced American Steel & Wire field service representatives.

For more information, write American Steel & Wire, 614 Superior Ave., N.W., Cleveland 13, Ohio.

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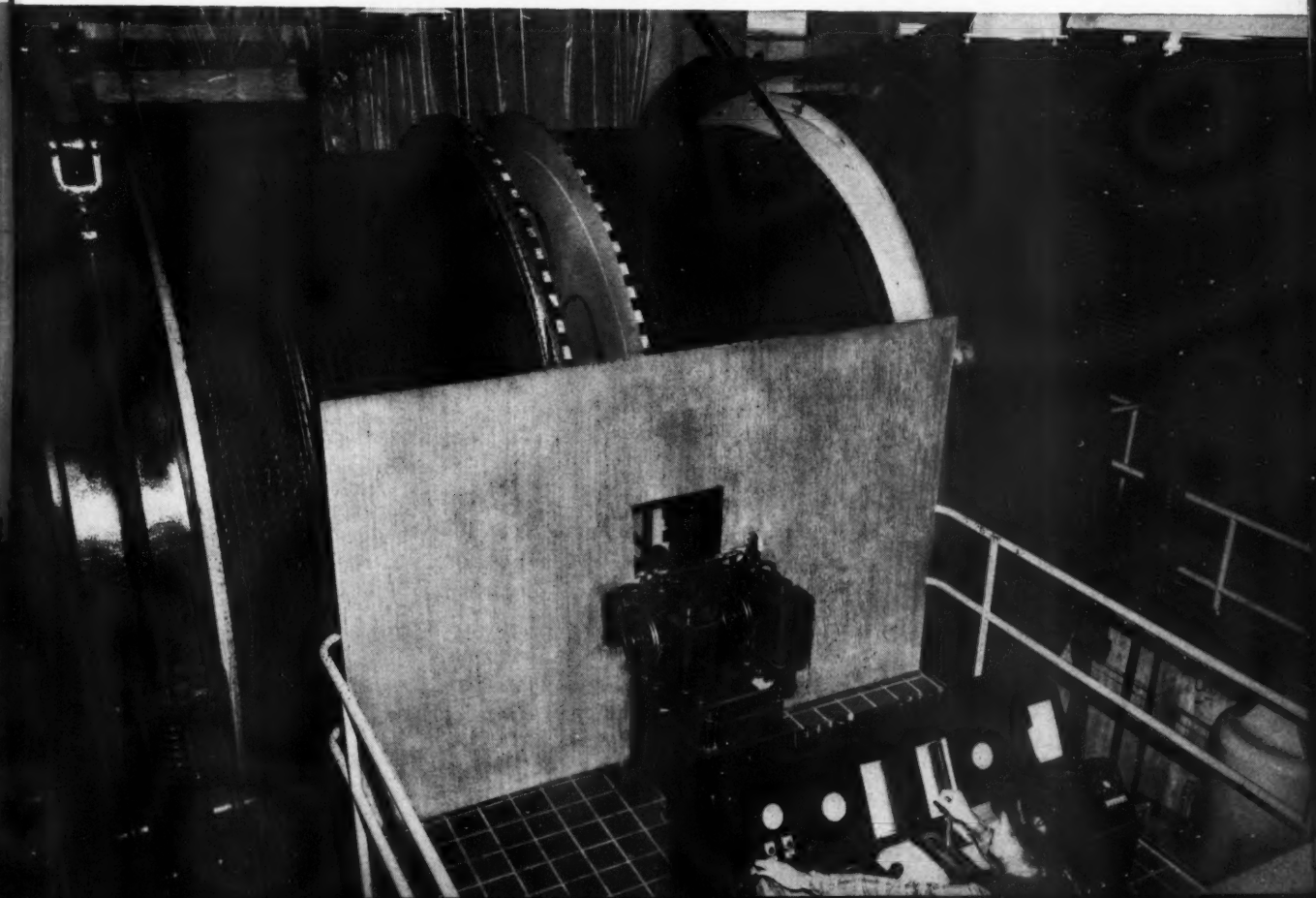
Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
Tennessee Coal & Iron Division, Fairfield, Alabama, Southern Distributors
United States Steel Export Company, Distributors Abroad

Wire Rope

USS Tiger Brand Wire Rope on the huge 12-foot diameter skip hoist drums. Skip operator can tell when skip is loaded by a series of different colored lights. Depth indicators show position of each skip.



HAVE YOU SEEN "THE MAN WITH THE RED VALISE"?

Every Hercules Explosives technical representative carries "The Red Valise" you see above. In it are dummies of Hercules® Blasting Caps; with it in front of you, you and the Hercules man can determine the best materials for your specific requirements.

Talking with the Hercules man is always a good idea. He's been expertly trained in his field, and backing him up is a complete line of quality materials for the industrial explosives user. You can always receive the help you need from Hercules, either by contacting the Hercules sales office nearest you or by writing direct to Wilmington.

Explosives Department

HERCULES POWDER COMPANY

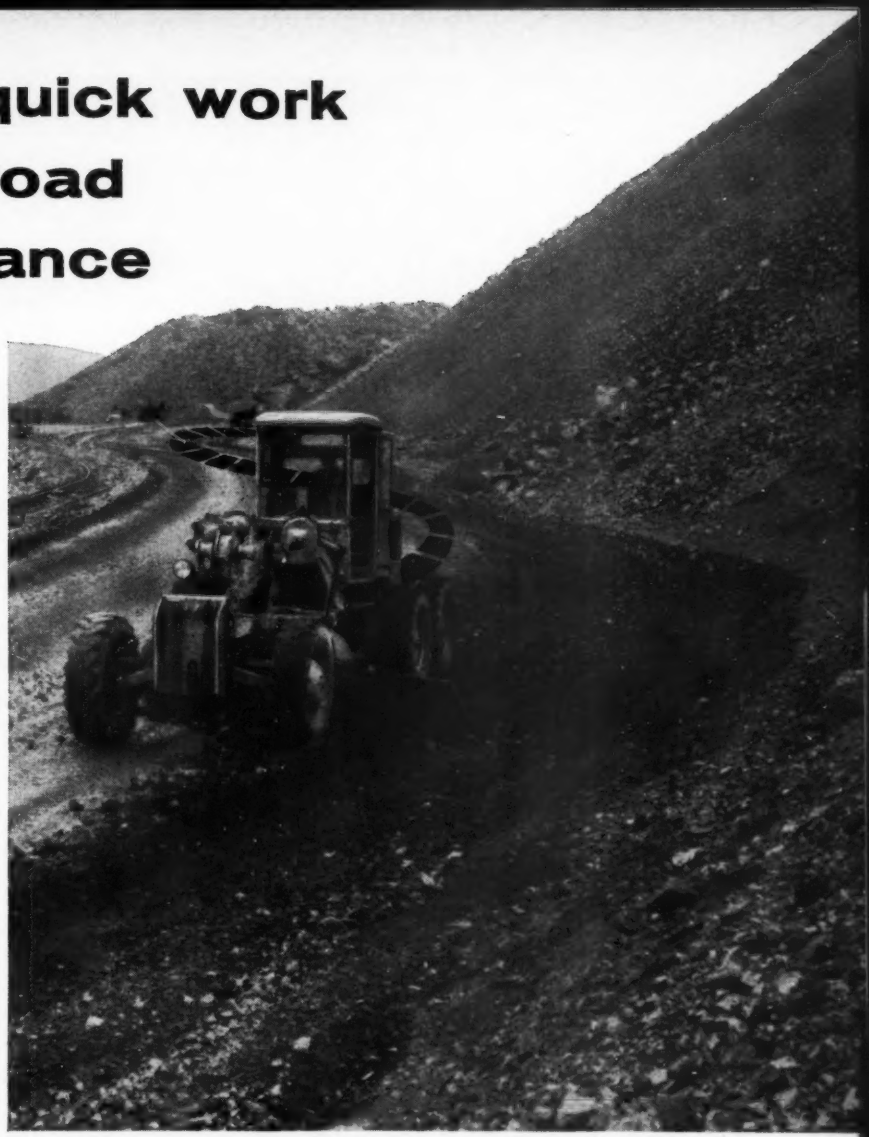
INCORPORATED

900 Market Street, Wilmington 99, Delaware

XR60-3

BIRMINGHAM • CHICAGO • DULUTH • HAZLETON • JOPLIN • LOS ANGELES • NEW YORK • PITTSBURGH • SALT LAKE CITY • SAN FRANCISCO

Makes quick work of haul-road maintenance



Powerful L-W Adams 660 — at large open-pit mine in Arizona — patrols busy haul roads 24 hr a day, 6 days a week. Grader goes wherever needed (at speeds to 26 mph) to fill ruts, level washboard, clear debris dropped by overloaded haulers and improve drainage.

You know from experience that using the *right* tool on any job completes the work faster and easier. The same holds true when maintaining your haul roads, pit floor, dump areas around crusher, and stockpiles, or waste dump. Use a heavy-duty L-W Adams† grader for these maintenance assignments. You'll find you can complete this work *faster* and *at lower cost.*

Greater work range

All LeTourneau-Westinghouse 85, 115, 123, and 160 hp Adams graders have constant-mesh transmission as standard, with 8 forward and 4 reverse speeds. In addition, 3 optional creeper speeds provide extra lugging power for turning up rocky subsurfaces and for greater grading accuracy. Choice of 15 gear ratios give you the balance of power and speed to handle every grading job . . . in any material . . . at top efficiency.

Smooth, accurate control

Adams' blade mechanism is firmly mounted on a heavy-duty circle for chatter-free operation. Strong T-shaped drawbar gives L-W grader firm circle support for accurate blading in any material.

Blade positioning is fast . . . it swings maximum arc from deep ditch-cut to high bank-cut in less than a minute. Moldboard turns 360° — clockwise or counter clockwise — provides quick change from any forward work position, to desired angle for reverse ditching and grading.

Low operating costs

All gears operate on anti-friction bearings — for less wear, easier operation. Automatic braking on transmission, when hydraulic brakes are applied to wheels, gives safer operation and less maintenance. And because L-W power-control clutches shift on ball bearings, you have easier, smoother, safer controls . . . assuring accuracy, speed, and performance with minimum upkeep.

Keeps busy all year

Between regular assignments, your LeTourneau-Westinghouse grader need not sit idle. With available attachments, such as Jebco Elegrader, bulldozer blade, scarifier, snow plow and wing, you can keep this grader busy on your property the year round. Also, grader's high travel speeds (to 26 mph) permit the profitable handling of jobs for adjoining pits. There are 6 models available — 85 to 190 hp. Your choice of GM or Cummins engines on all LW graders. The 190 and 145-hp POWER-*Flow*® models have torque-converter drive . . . will do more work faster than any other graders on the market. Call or write for a demonstration today!

†Trademark G-1874-MQ-1

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

ROOF BOLTING THAT INCREASES PRODUCTION

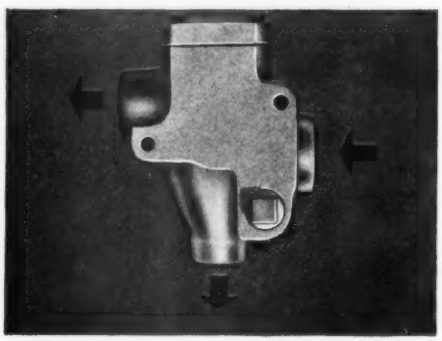
The ACME Model HSJ-4WD Jumbolter can work an area 23′ 10″ wide without moving. The air-articulated arms reach out 9′ in front of the machine. Each arm operates independently and swings 270 degrees.

with

ACME 4 WHEEL DRIVE A.C. or D.C. JUMBOLTER

The versatile ACME Model HSJ-4WD Jumbolter, equipped with tractor-type 4 WHEEL DRIVE, insures minimum turning radius. Left hand and right hand wheels are integrated units. By reversing the wheels on one side while driving forward on the other side the ACME JUMBOLTER will turn in its own approximate diagonal.

This unit, now successfully operating under a variety of conditions, permits bolting in a wide flexible pattern from 8 to 10 feet back of the working face.



An Easy Way to SAVE DOLLARS on Your Air Supply

ACME'S new dust collector shut-off valve stops the operation of the dust collector when the stopers are idle between steel changes, etc. Controlled from the throttle valve of the stoper this simple, mechanical, fully automatic valve synchronizes the operation of the drill and the dust collector. It can be easily installed on your present Le Roi dust collecting system and will substantially lower operator fatigue by eliminating unnecessary dust collector noise. Designated the Model APC-77, the valve is modest in cost.

ACME MACHINERY COMPANY

ACME MACHINERY COMPANY

HUNTINGTON, WEST VIRGINIA

WAREHOUSE AND SALES OFFICE
MORGANTOWN, OHIO

REPRESENTATIVES IN PRINCIPAL MINING AREAS

faster loading . . .

LW Rear-Dumps position fast . . . usually spot under shovel in one continuous motion, with little "jockeying". Wide, unobstructed top opening gives your shovel-operator easy "target". Low rear entry speeds dipper swing, reduces spillage.

hauls anywhere . . .

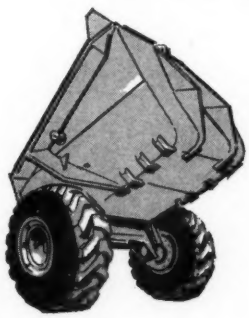
Rough haul roads, uneven terrain, sticky mud . . . no problem for LW Rear-Dumps! Wide, low-pressure tires, famous LW power-transfer differential, balanced weight distribution, electric-steer, all help provide go-anywhere traction.

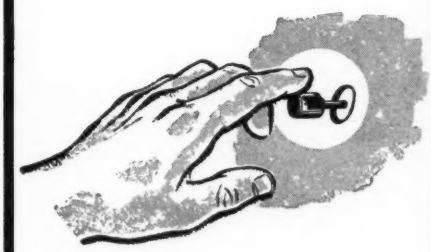
dumps cleaner . . .

Electric motor raises tapered bowl fast and material dumps quickly. End of bowl extends beyond rear wheels for clean over-bank dumping. Electric controls permit fast dump or controlled spread. Front-wheel-drive permits easy pull-out.

These LW Rear-Dump features serve you two ways...

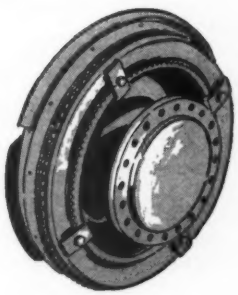
1. bigger production...
2. lower handling costs





easier operation . . .

Production stays high all day-long-because many fatigue-factors are reduced. Big tires, big foam-cushion seat, smooth out ride for operator. Fingertip electric-switches give speed-of-light control with little effort.



greater safety . . .

Multi-disc air brakes provide more brake surface per wheel than most haulers have on four wheels. Low center of gravity, excellent visibility, front-wheel-drive, and easy control . . . all increase safety.

easier to own . . .

LW Rear-Dumps are competitively-priced. Because they last longer, cost less to maintain, and produce more, your savings are substantial. They pay bigger dividends, faster, on your investment.

insures faster earnings . . .

Behind same Tournapull® prime-mover you can interchange scraper, crane, bottom-dump, and other trail units. With them, you can increase your work capacity for bigger year-round profit.

job-proven . . .

LW Rear-Dumps prove profitable wherever there's shovel material to be hauled. Hundreds of these versatile machines are in use in mines and quarries all over the world. Three sizes: 11, 22, and 35 tons.

RD-2232-M-1

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit.

THE DUTCH STATE MINES HEAVY MEDIUM CYCLONE WASHER

Available in the United States exclusively from

ROBERTS & SCHAEFER

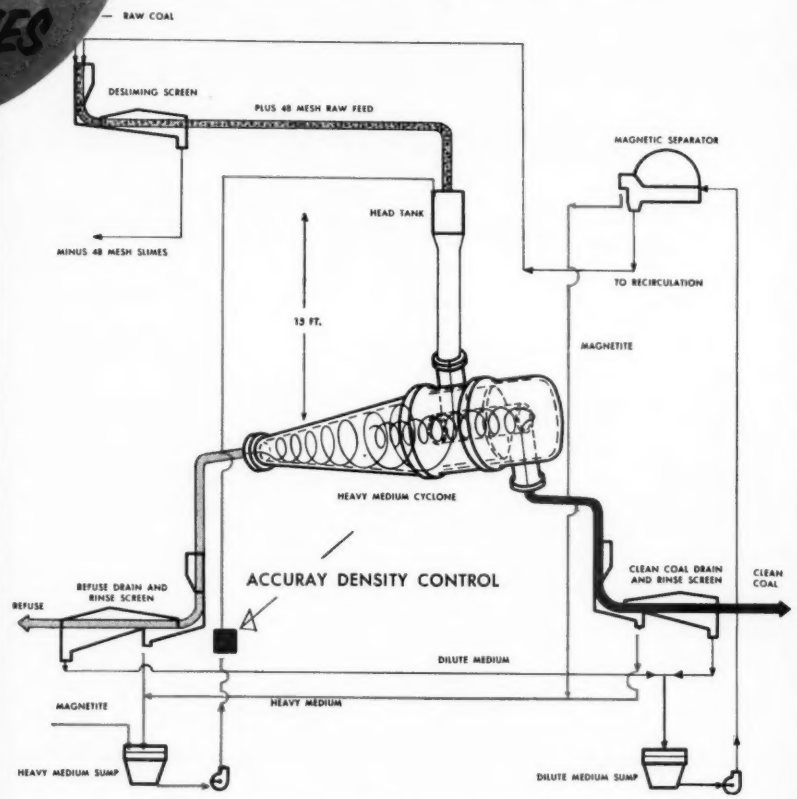
If you are facing the necessity of upgrading the quality of your fine coal to meet the exacting requirements of today's market, you can install the Dutch State Mines Heavy Medium Cyclone Washing System with complete confidence.

It is the only cyclone washing system proved sound, practical and efficient by successfully operating plants in many countries. It is the only system that gives you the advantages of the technical knowledge and experience of the Dutch State Mines engineering organization.

The Roberts & Schaefer technical staff handles all details of engineering and construction of Heavy Medium Cyclone Washing Plants . . . with the continuing collaboration of the Dutch State Mines engineers on installations in United States.

The Dutch State Mines Heavy Medium Cyclone Washer is available in the United States exclusively from Roberts & Schaefer. Call or write us for detailed information.

FLOW DIAGRAM OF HEAVY MEDIUM CYCLONE WASHING SYSTEM



"AccuRay" IS THE REGISTERED TRADE-MARK OF INDUSTRIAL NUCLEONICS CORPORATION

A Personal Invitation to Visit Our New Offices

During recent weeks we have had the pleasure of welcoming many of our friends in our new general offices in Chicago. Here at 201 North Wells Street, our executive staff and engineering organization now have greatly expanded space and the most modern facilities to serve the coal mining industry. When you are in Chicago, do come in and visit with us.

WILLIAM C. McCULLOCH
President

ENGINEERS & CONTRACTORS

ROBERTS & SCHAEFER *Company*

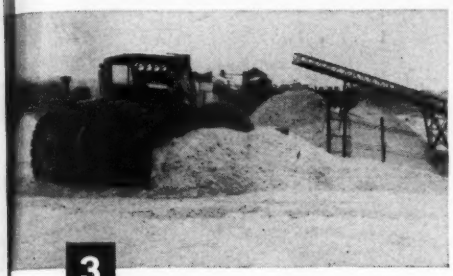
201 NORTH WELLS STREET, CHICAGO 6, ILLINOIS

NEW YORK 19, N. Y. • PITTSBURGH 22, PA. • HUNTINGTON 10, W. VA. • ST. PAUL 1, MINN.

DIVISION OF THOMPSON-STARRETT COMPANY, INC.

7 widely-separated shovels . . .

2 Cleans-up pit-floor after blasting . . .



3 Levels and compacts stockpiles . . .

How heavy rubber-tired tractor cuts pit clean-up costs

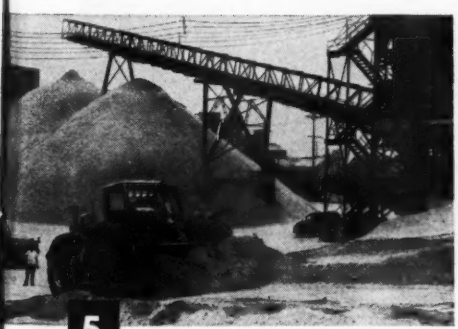
4 Handles clean-up at waste dumps . . .

At Texas, Maryland, the Harry T. Campbell Sons' Corporation operates one of the largest limestone quarries in the eastern states. With a half-dozen shovels, and numerous stockpiles over a considerable area, the firm once kept 2 crawler tractors busy on maintenance and clean-up work. But like all track-type tractors, the rigs spent about as much time just going from job-to-job as they did working.

"We bought Tournatractor to do the work of a crawler tractor whose main job was to clean-up the quarry floors," says Superintendent Eddie Reichert. "It really moves around our pit and does a grand job."

Owners of the Harry T. Campbell Corp. agree. "It's Tournatractor's speed that does the trick," says Mr. Campbell . . . "Tournatractor completes the clean-up job so fast, that it is available to do many other jobs throughout the quarry operation. In addition this rubber-tired tractor requires less maintenance than any track-type tractor."

Illustrated and described here are some of the jobs handled by this "go-anywhere", rubber-tired LW tractor during a single work shift.



5 Cleans-up around crusher-grizzly as well as polices entire plant area . . .

6 Maintains haul roads as it "runs" from one job to the next . . .

See it in action

Let us show you how 17.2-mph, 218-hp Tournatractor can save you money on widely-separated dozing, towing and pushing jobs. Ask for complete facts and demonstration.

CT-2025-MQJ-1

LW

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

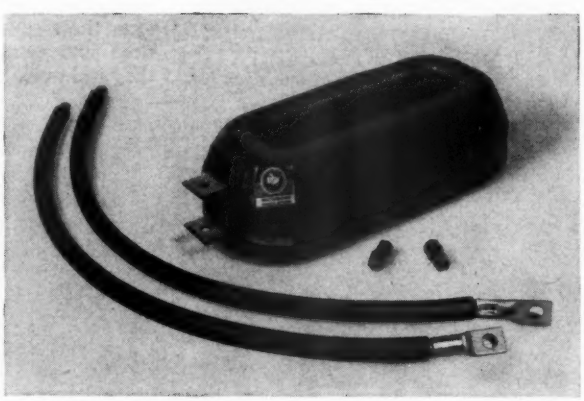
Rewound motors can be upgraded with NECCOBOND field coils by National ... *The Specialists in electric coils/repair service*

Rewinding time is an ideal opportunity to improve performance over that of the original machine . . . with the much more effective insulations available today.

For example, National manufactures field coils to your requirements with the NECCOBOND insulation system. The best insulating materials—mica and glass—are used. Then a high strength, inert epoxy resin is used to impregnate the whole coil. All voids are filled. The insulation wall is extremely tough, solid and durable.

NECCOBOND field coils upgrade performance. Coils operate cooler—insulation lasts longer and is impervious to water, oil, or other sources of trouble.

For more information call our Columbus plant—HUdson 8-1151, or the nearest National field engineer.



National Electric Coil

DIVISION OF McGRAW-EDISON COMPANY • COLUMBUS 16, OHIO

Electrical Engineers • Manufacturers of Electrical Coils, Insulation, Lifting Magnets
Redesigning and Repairing of Rotating Electrical Machines

THE ORIGINAL solid-woven PVC belting

THE MOST in tons of coal carried per dollar of cost

THE ONLY solid-woven PVC belting proved in American mining

is

Scandura®

GOLD PVC LINE

MINE BELTING

The weight of solid experience gives force to mining's favor for SCANDURA—first PVC belting in the field and leader in conveyor performance by every measure of comparison. When you specify Scandura for your long-haul or extensible needs, you get the lighter, flexible, stronger solid-woven belting that outruns all competition in service and savings. See your National Mine man for the facts on your application!

Manufactured at CHARLOTTE, NORTH CAROLINA

by Scandura INC.

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NATIONAL MINE SERVICE (CANADA) LIMITED
Elliot Lake, Ontario

National Mine Service Company

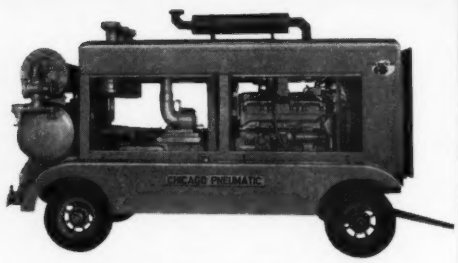
Koppers Building Pittsburgh 19, Pa.

During Project Development...

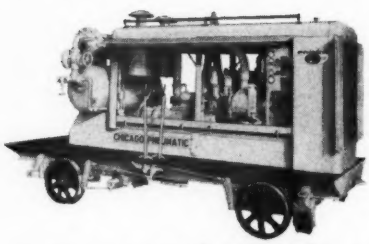
"POWER VANE" ROTARIES

supplied 21,775 CFM

18,000 CFM

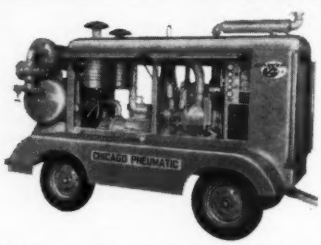


18 "Power Vane" Rotaries, 900 cfm, portable.

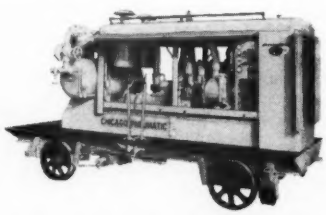


2 "Power Vane" Rotaries, 900 cfm, flange-wheel mounted, self-propelled.

3,650 CFM

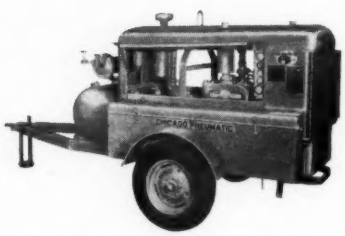


9 "Power Vane" Rotaries, 365 cfm, portable.



1 "Power Vane" Rotary, 365 cfm, flange-wheel mounted, self-propelled.

125 CFM



1 "Power Vane" Rotary, 125 cfm, 2-wheel portable.

TOTAL 21,775

At Toquepala, "Power Vane" Rotaries saw high altitude service. They maintained their industry-wide reputation during Project Development for *power* and *stamina* when air demands were heavy and the going was rough.

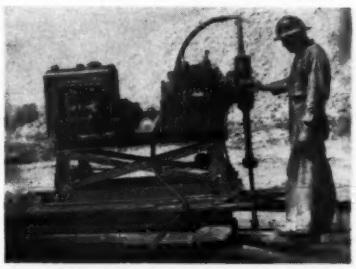
CP Tracdrils — all drill positions are obtained hydraulically. Fast-acting cylinders quickly convert fast from wide verticals to snake hole position . . . let you drill at any angle.

at TOQUEPALA...

Hard Working "Power Vane" Rotaries and CP Mining Equipment help set footage records... everywhere!

CP TRACDRILS move quickly and easily over the roughest ground. Every drill position sets up fast! Sure-footed, they'll tow their own compressor up an 18% grade. Operator safety is assured by automatic brakes that take hold the instant traction motors are stopped, keep drill in position on steep inclines or bad ground. Hard-hitting 4½" bore Deep-Hole Drills sink 3" holes to 75 feet in hard rock . . . a real "Drillers Drill".

CP DIAMOND DRILLS are available in two types: Skid-mounted and Column-mounted. Skid-mounted units, gasoline, diesel or air driven, keep core costs low. Column-mounted units have a world-wide reputation for top performance on underground blast-holing and coring operations. Short length and light weight let you handle this highly productive drill with the ease of a drifter.



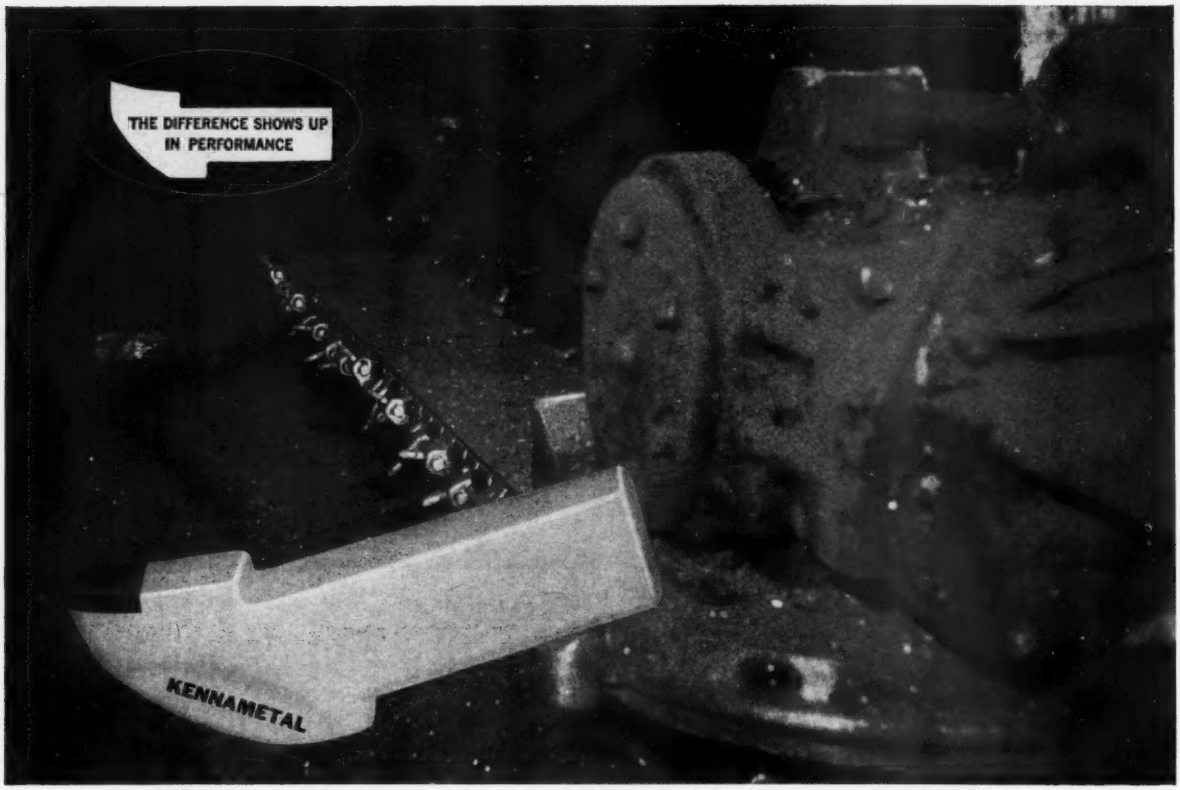
Above: CP-8 Exploratory Diamond Drill — skid-mounted for easy hole-to-hole movement. Capacity: 1250 feet with EW-EX Fittings.

Below: CP-65 Diamond Drill, ideal for blast-hole or coring. 50% more motor power . . . reversible. Only 42½" overall, weighs just 200 lbs. Capacity: 600 feet with EW-EX Fittings.

REICHdrills are all-hydraulic, top-drive rotaries that are breaking footage records in all formations. Hole sizes to 16" diameter, down-pressures to 90,000 lbs.

Chicago Pneumatic *8 East 44th Street, New York 17, N. Y.*

AIR COMPRESSORS • PNEUMATIC AND ELECTRIC TOOLS • AIR-BLAST BITS • DIAMOND DRILLS • REICHdrills • ROCK DRILLS



Kennametal U4 Bits installed on the 9-foot bar of a universal cutter

Fast cutting KENNAMETAL U4 Bits cut 30% more places every shift

Using other bits, 10 or 12 places a shift was the best that two men could cut from the Lower Kittanning Seam near Philippi, West Virginia. Seam thickness averages 44 inches, with rooms being driven 20 feet wide.

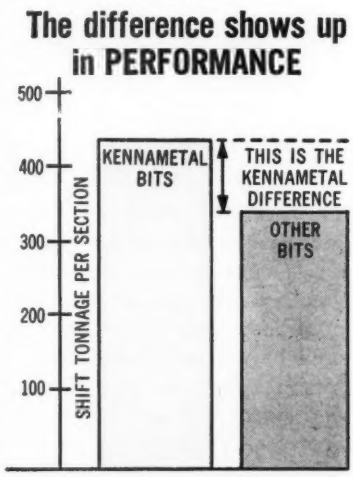
Despite the rolls of fire clay that make undercutting difficult, a switch to Kennametal U4 Bits increased the average to 16 places a shift. They have cut as many as 21 a shift.

As indicated by the graph, increased production has made a big profit difference. Bit costs have dropped too . . . down to 1.4 cents a ton. And the company reports less fines and reduced wear on the bit blocks.

Let the Kennametal difference show up in performance at your mine. Your Kennametal Representative will help you select and actually test Kennametal bits in your mine. You can't judge performance by appearance or a price tag. Call him, or contact us direct. KENNAMETAL INC., Mining Tool Division, Bedford, Pa.

- Consistently high quality keeps Kennametal bits in service longer . . . resulting in fewer bit changes and more operating time at the face.
- Free-cutting design of Kennametal bits draws less power, permits faster cutting, maximum production, less maintenance.
- Every Kennametal bit is backed by 21 years of leadership in tungsten carbide tooling, including the development of the first carbide cutter bits for the American mining industry.
- Nineteen full-time Kennametal Representatives and the Kennametal Distributors—leading mine supply companies, provide assistance in solving your cutting and drilling problems . . . the tools you need . . . when you need them.

97243



For this mine, Kennametal Bits mean the difference between 324 tons and 432 tons . . . 108 tons from a section, every shift!

INDUSTRY AND KENNAMETAL
. . . Partners in Progress

EDITORIALS

ROBERT W. VAN EVERA, Editor

APRIL 1960

COAL CONVENTION HIGHLIGHT

Secretary of the Interior Fred A. Seaton's attendance and participation in the 1960 Coal Convention of the American Mining Congress will, we believe, prove of mutual benefit to the cabinet officer and to coal industry leaders attending the meeting.

The Secretary, who is charged with over all direction of Government mineral resource programs, has welcomed the opportunity of expressing his views at the May 9 luncheon to an audience vitally interested in his thinking. Mining men, on the other hand, will be able to show by their attendance that they are indeed aware of the importance of the Interior Department's programs to the coal industry.

LOST IN THE WILDERNESS

For several years now, spokesmen for the mining industry have found themselves opposing legislation which has been represented—and almost sold—to the public and the Congress as a means of insuring future recreational development of the public domain. This awkward state of affairs has come about, not because miners oppose recreation, but because advocates of single use of public lands have succeeded in confusing the meaning of the word "recreation" in the minds of many. As a result, a large and vocal group has become convinced, temporarily we hope, that "recreation" and "mining" insofar as they would occur in the same areas of the public domain are mutually exclusive.

This is merely troublesome when small areas are closed to mining location and development in the name of "recreation." It becomes a serious problem, not only for the industry but for the nation, when the same misrepresentations are used to gain support for legislation to close vast areas to any future mineral development. The so-called "wilderness" bills are a product of this type of thinking.

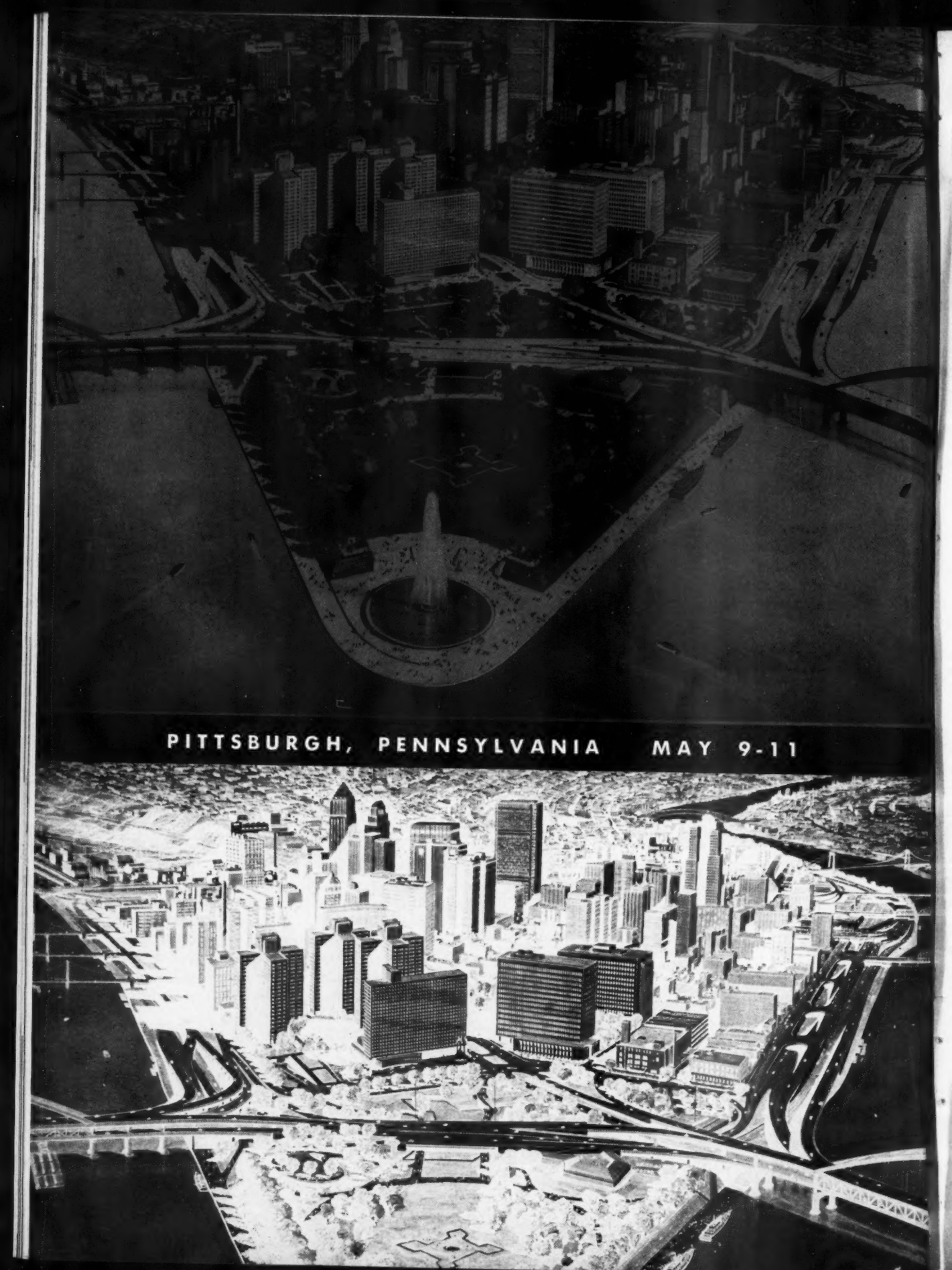
The extractive industries, including mining, have marshaled an imposing array of figures showing the contributions they have made and are making to the wealth of the nation—contributions that would not have been possible had our ancestors embraced the "wilderness preservation" theory. To further bolster the industry's position, we believe that a clear and factual analysis of the relationship between mining development and recreation is needed.

The mining industry has nothing to fear from such an analysis. No segment, private or public, of our economy has done more to open new areas for recreational use than has mining. Literally hundreds of our nation's present recreational areas were, in the beginning, mining developments. Aspen, Colo.; Brighton and Alta, Utah, and countless other western ski and snow paradises were first opened by miners. Roads and trails laboriously hacked through the wilderness to mining locations have today become highways to recreation areas. And this is a continuing process. A decade ago the spectacular scenic area of the "Four Corners" country in Utah, Arizona, New Mexico and Colorado, was virtually roadless. It had scenery, yes, but a crow couldn't fly to it. Now, thanks to uranium location and development, roads penetrate this wilderness—and another vast recreational resource has become accessible.

In many cases the very features created in the process of mining have added historic meaning and charm to otherwise uninteresting areas.

Examples of the industry's contribution to recreation are not limited to the West. Wise reclamation and reforestation practices in our eastern coal mining states are contributing new hunting and fishing resources to the public. Similar contributions to the development and enhancement of recreational wilderness areas are taking place throughout the nation—wherever there is, or has been mining.

Despite this record of mining-recreation progress, the industry is continually faced with legislation that would restrict mining in the name of recreational development. The mining industry must continue to emphasize and prove that mining and recreational development go hand-in-hand.



PITTSBURGH, PENNSYLVANIA MAY 9-11

Pittsburgh, the Coal Capital of the World, has brushed off the welcome mat and polished up the key to the city in its preparations to host the 1960 Coal Convention of the American Mining Congress, May 9–11. Coal mine operators and equipment manufacturers are also making their plans for the industry's most important single event of the year, and a large attendance is anticipated.

A nation-wide Program Committee headed by Robert H. Hughes, President, Clinchfield Coal Co., has arranged a balanced and comprehensive program of general addresses and technical papers. Starting with a discussion of National Fuels Policy at the opening session and extending through the last technical session Wednesday afternoon, the emphasis will be on "Progress", with an outstanding array of speakers covering the latest developments in Government relations with coal, underground and strip mining, management techniques, safety and coal preparation.

Interior Secretary Seaton to Address Convention

Of special interest will be the Welcoming luncheon, Monday, May 9, at which the Honorable Fred A. Seaton, Secretary of the Interior, will make the feature address. His position as the Cabinet officer responsible for formulating and administering fuels and mineral policy makes his appearance of particular importance to the industry.

At a second luncheon, Tuesday, May 10, Richard Harkness, well known NBC commentator, will analyze events behind the top national and international news of the day.

Mining men connected with the financial side of the industry will want to attend

1960 amc coal convention

Raymond E. Salvati
President, Island Creek Coal Co.
President, American Mining Congress

Jesse F. Core
Vice President—Operations—Coal
U. S. Steel Corp.
Chairman, Coal Division

Robert H. Hughes
President, Clinchfield Coal Co.
Chairman, Program Committee

Albert E. Seep
President, Mine & Smelter Supply Co.
Chairman, Manufacturers Division

George C. Breidenbach
Chairman
Welcoming Committee

the all-day Tax Forum, Wednesday, May 11, at which current tax problems of the coal industry will be fully discussed.

Technical Sessions Cover Wide Range of Subjects

Details of the convention program are outlined on the following pages. A brief review will show why so many progressive mining men are planning to attend the 1960 AMC Coal Convention.

On Monday afternoon thin seam and strip mining will be featured. The thin seam session will cover both conventional and continuous mining, plus the work of the U. S. Bureau of Mines on hydraulic coal mining. Recent developments in drilling and blasting will be spelled out at the strip mining session; and the electric wheel drive will be given full coverage.

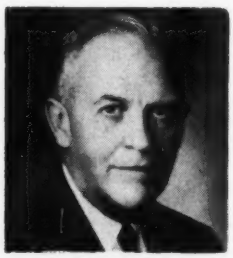
The first of two coal preparation sessions will be held Tuesday morning. Topics to be discussed include economic aspects of coal preparation, progress in plant automation, maintenance, and new developments in preparing anthracite. Recent advances in safety will be stressed at the other Tuesday morning meeting, which covers progress in roof control — including roof cementation and sonar exploration of roof rocks — progress in ventilating continuous mining sections, and fire fighting experience.

Strip mining and underground haulage will be featured Tuesday afternoon. One session will be devoted to aerial photography and mapping, land reclamation, maintenance, and earthmoving equipment as a supplemental tool to stripping shovels. At the other, new developments in mine haulage, maintenance, and conversion of an existing manual hoist to automatic operation will be covered.

R. L. Ireland
Chairman
Land & Water Use Committee

Wednesday morning, management and cost controls and underground power will hold sway. People, personnel selection, and use of electronic computers in coal mining will be dealt with at one session. Topics to be discussed at the power session include design of a power system for a new mine, silicon rectifiers, experience with a-c mining, maintenance, and extending trailing cable life.

Coal preparation and thick seam mining will be considered Wednesday afternoon. A thorough discussion of fine coal cleaning and drying is scheduled for this second meeting on coal preparation. The other session will highlight conventional versus continuous mining in thick seams and equipment needs and trends, plus a paper on productivity of continuous and conventional mining equipment.



Julian D. Conover
Executive Vice President
American Mining Congress

One of the greatest benefits to those attending the convention sessions will be the information that comes forth spontaneously in floor discussions; hence, as always, questions and observations from the audience will be invited.

Interesting Trips Arranged

Thursday, May 12, has been set aside for visits to two modern coal mine operations. One trip will be made to

(*Continued on page 43*)

Chairmen and Vice Chairmen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convention headliners

Fred A. Seaton
Secretary of the Interior

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convention program

MONDAY MORNING—MAY 9

Ballroom 1—Pittsburgh Hilton Hotel

9:15 A.M.—Pre-Session Motion Picture
"Alaska . . . Land to Grow On"

9:45 A.M.—OPENING SESSION

Opening of Convention

RAYMOND E. SALVATI, President, Island Creek Coal Co.; President, American Mining Congress

Invocation

DR. CHARLES P. ROBSHAW, Pastor, East Liberty Presbyterian Church, Pittsburgh, Pa.

NATIONAL FUELS POLICY— A Panel Discussion

Presiding

GEORGE H. LOVE, Chairman of the Board, Consolidation Coal Co.

Panelists

HON. ELMER F. BENNETT, Under Secretary of the Interior

HON. WAYNE N. ASPINALL, U. S. Representative from Colorado; Chairman, House Committee on Interior and Insular Affairs

HON. FRANK E. MOSS, U. S. Senator from Utah

HON. JOHN P. SAYLOR, U. S. Representative from Pennsylvania

DR. FRANK K. PITTMAN, Director, Division of Reactor Development, Atomic Energy Commission

R. A. KAMPMEIER, Assistant Manager of Power, Tennessee Valley Authority

Discussion

STEPHEN F. DUNN, President, National Coal Association

JOSEPH E. MOODY, President, National Coal Policy Conference, Inc.


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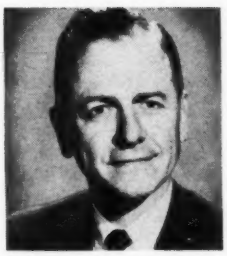
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MONDAY AFTERNOON—MAY 9

Ballroom—Penn-Sheraton Hotel

1:45 P.M.—Pre-Session Motion Picture
"The Goer"

2:15 P.M.—STRIP MINING

Chairman: S. F. SHERWOOD, President, Stonefort Coal Mining Co., Inc., Indianapolis, Ind.

Vice Chairman: J. J. HUEY, Director of Plant & Equipment Engineering, United Electric Coal Companies, Chicago, Ill.

Recent Developments in Blasting Overburden

DR. GEORGE B. CLARK, Chairman, Department of Mining Engineering, University of Missouri, School of Mines and Metallurgy, Rolla, Mo.

Moving Overburden with Explosives

AUGUST MANIFEST, Mine Superintendent, Marco Coal Co., Apollo, Pa.

The Electric Wheel Drive

E. R. BORCHERDT, Borcherdt & Smith, San Francisco, Calif.

Discussion

WAYNE MCGLADE, Manager, Product Development, LeTourneau-Westinghouse Co., Peoria, Ill.

J. L. VINT, JR., President, Unit Rig & Equipment Co., Tulsa, Okla.

(*Continued on next page*)

12:00 NOON—WELCOMING LUNCHEON

Ballrooms 2, 3 & 4—Pittsburgh Hilton Hotel

Presiding

RAYMOND E. SALVATI, President, American Mining Congress

Presentation of the Colors

Welcome to Pittsburgh

HON. JOSEPH M. BARR, Mayor of Pittsburgh

Responses

JESSE F. CORE, Vice President—Operations—Coal, U. S. Steel Corp.; Chairman, Coal Division, American Mining Congress

ROBERT H. HUGHES, President, Clinchfield Coal Co.; Chairman, Program Committee, 1960 Coal Convention

ALBERT E. SEEP, President, Mine & Smelter Supply Co.; Chairman, Manufacturers Division, American Mining Congress

Address

HON. FRED A. SEATON, Secretary of the Interior

Urban Room—Penn-Sheraton Hotel

1:45 P.M.—Pre-Session Motion Picture
"White Wonder"

2:15 P.M.—THIN SEAM MINING

Chairman: GEORGE E. EVANS, JR., President, Evans Elkhorn Coal Co., Inc., Wayland, Ky.

Vice Chairman: L. I. COTHERN, Director of Engineering, Jewell Ridge Coal Corp., Tazewell, Va.

Conventional Mining in Thin Seams
E. W. POTTER, Vice President and General Manager, Royalty Smokeless Coal Co., Clifftop, W. Va.

Continuous Mining in Thin Seams
K. S. HOBBS, Mine Superintendent, Eastern Gas & Fuel Associates, Helen, W. Va.

Equipment Needs and Trends for Thin-Seam Mining
NEIL ROBINSON, Robinson & Robinson, Charleston, W. Va.

Research in Hydraulic Coal Mining
JOSEPH J. WALLACE, Supervising Mining Methods Research Engineer, U. S. Bureau of Mines, Pittsburgh, Pa.

2:30 P.M.—ANNUAL MEETING

Manufacturer's Division,
American Mining Congress
Monongahela Room—Penn-Sheraton Hotel

7:00 P.M.—COAL MINERS PARTY

Main Ballroom—Pittsburgh Hilton Hotel
Dinner, Dancing and a Top-Flight Floor Show

TUESDAY MORNING—MAY 10

Ballroom 1—Pittsburgh Hilton Hotel

9:00 A.M.—Pre-Session Motion Picture
"This is Bermuda"

9:30 A.M.—SAFETY

Chairman: WILLIAM E. HESS, Manager of Mines, Jones & Laughlin Steel Corp., California, Pa.

Vice Chairman: D. C. RIDENOUR, General Superintendent, Olga Coal Co., Coalwood, W. Va.

Progress in Roof Control—A Panel Discussion

Roof Cementation
D. F. CRICKMER, Chief Engineer, Pocahontas Land Co., Bluefield, W. Va.

Sonar Exploration of Roof Rocks
DR. CHARLES E. MONGAN, JR., Consulting Physicist, Cambridge, Mass., and
THOMAS C. MILLER, Mining Health & Safety Engineer, U. S. Bureau of Mines, Pittsburgh, Pa.

A Practical Look
A. V. GIBSON, Division Superintendent, New River & Pocahontas Consolidated Coal Co., Havaco, W. Va.

Progress in Ventilating Continuous Mining Sections
C. H. PATTERSON, Safety Director, Rochester & Pittsburgh Coal Co., Indiana, Pa.

Discussion
JOHN B. KEBBLISH, General Superintendent, Mountaineer Coal Co., Fairmont, W. Va.

Fire Fighting Experience
W. K. DENNISON, JR., Mine Superintendent, Kaiser Steel Corp., Raton, N. M.

Ballroom 2—Pittsburgh Hilton Hotel

9:00 A.M.—Pre-Session Motion Picture
"Heart of the Rockies"

9:30 A.M.—COAL PREPARATION

Chairman: R. M. VON STORCH, General Superintendent, Coal Mines & Quarries, Columbia-Geneva Steel Div., U. S. Steel Corp., Provo, Utah

Vice Chairman: A. P. MASSMANN, Preparation Superintendent, Peabody Coal Co., St. Louis, Mo.

Some Economic Aspects of Coal Preparation
F. R. ZACHAR, Consulting Engineer, Morgantown, W. Va.

Progress in Preparation Plant Automation
R. E. JOSLIN, Manager Preparation, Clinchfield Coal Co., Dante, Va.

Discussion
L. A. UPDEGRAFF, Project Engineer, Bituminous Coal Research, Inc., Columbus, Ohio

Preparation Plant Maintenance
DAVID G. WERNER, Maintenance Engineer, Pittsburgh Coal Co., Library, Pa.

What's New in Anthracite Preparation?
J. E. IPPOLITI, Chief Engineer, Wilmott Engineering Co., White Haven, Pa.

12:00 NOON—LUNCHEON

Ballroom—Penn-Sheraton Hotel

Presiding
ALBERT E. SEEP, Chairman, Manufacturers Division, American Mining Congress

Address
RICHARD HARKNESS, NBC News Commentator

TUESDAY AFTERNOON—MAY 10

Urban Room—Penn-Sheraton Hotel
1:45 P.M.—Pre-Session Motion Picture
"Quebec Cartier"

2:15 P.M.—STRIP MINING

Chairman: R. S. WALKER, President, Bradford Coal Co., Bigler, Pa.

Vice Chairman: A. E. CODDINGTON, Vice President, Carey, Baxter and Kennedy, Inc., Mahanoy City, Pa.

The Application of Electronics to Surveying
GEORGE L. HESS, Sales Engineer, Aero Service Corp., Philadelphia, Pa.

Land Reclamation
DR. WALTER H. SCHOEWE, Division of Mineral Economics & Coal, State Geological Survey of Kansas, University of Kansas, Lawrence, Kan.

Discussion
C. H. J. BREEDING, Field Director, Ohio Reclamation Association, Cambridge, Ohio

Maintenance of Strip Mining Equipment

(a) Wire Rope
A. F. MEGER, Assistant Chief Engineer, Wire Rope Division, John A. Roebling's Sons Corp., Trenton, N. J.

(b) Mobile Equipment
R. M. LESENEY, Mechanical Superintendent, Truax-Traer Coal Co., Fiatt, Ill.

Earthmoving Equipment as a Supplemental Tool to Stripping Shovels
C. J. COOPER, Instructor in Open Pit Mining, University of Pittsburgh, Pittsburgh, Pa.

Monongahela Room—Penn-Sheraton Hotel
2:00 P.M.—Pre-Session Motion Picture
"Trail Blazers"

2:15 P.M.—UNDERGROUND HAULAGE

Chairman: DAVID INGLE, JR., President, Ingle Coal Corp., Elberfeld, Ind.

Vice Chairman: JOHN W. STRATON, General Manager, The Lorado Coal Mining Co., Lorado, W. Va.

New Developments in Mine Haulage

(a) Belts
H. W. MEADOR, JR., General Superintendent, Stonega Coke and Coal Co., Big Stone Gap, Va.

(b) Rail
W. H. COGHILL, Assistant Chief Industrial Engineer, Mines, Industrial Engineering Department, Republic Steel Corp., Cleveland, Ohio

A New Development in Shuttle Car Haulage
JOHN S. TODHUNTER, General Manager, Barnes & Tucker Co., Barnesboro, Pa.

Conversion of Existing Manual Hoist to Automatic Operation
HOLLIS PIERCE, Chief Electrical Engineer, Old Ben Coal Corp., Benton, Ill.

Haulage System Maintenance

(a) Belts
BUDDIE R. MORRIS, Head, Industrial Engineering Department, West Kentucky Coal Co., Inc., Madisonville, Ky.

(b) Rail
J. S. SCHRENCENGOST, Chief Engineer, Allegheny River Mining Co., Kittanning, Pa.

WEDNESDAY MORNING—MAY 11

Sky Room—Penn-Sheraton Hotel
9:30 A.M.—TAX FORUM (All Day)
Chairman: LINCOLN ARNOLD, Chairman, Tax Committee, American Mining Congress

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Ballroom 1—Pittsburgh Hilton Hotel
9:00 A.M.—Pre-Session Motion Picture
"Frontier Beyond the Sky"

9:30 A.M.—MANAGEMENT AND COST CONTROLS

Chairman: R. H. JAMISON, JR., President, Delmont Fuel Co., Hunkers, Pa.

Vice Chairman: GEORGE MCCAA, General Manager, Hanna Coal Co., Moundsville, W. Va.

People
JAMES L. HAYES, Dean, School of Business Administration, Duquesne University, Pittsburgh, Pa.

Personnel Selection—A Panel Discussion
DR. QUIN F. CURTIS, Chairman, Department of Philosophy & Psychology, West Virginia University, Morgantown, W. Va.
C. G. EVANS, Personnel Manager, The North American Coal Corp., Cleveland, Ohio
JOHN N. CRICHTON, Executive Vice President, Johnstown Coal & Coke Co., Johnstown, Pa.

Use of Electronic Computers in Coal Mining—Two Papers
R. D. C. MORRIS, Assistant to Vice President—Coal, U. S. Steel Corp., Pittsburgh, Pa.
W. L. ZELLER, Assistant Industrial Engineer, Frick District, U. S. Steel Corp., Uniontown, Pa.

(Continued on next page)

Ballroom 2—Pittsburgh Hilton Hotel

9:00 A.M.—Pre-Session Motion Picture
"A City is Born"

9:30 A.M.—UNDERGROUND POWER

Chairman: JOHN STACHURA, Vice President, Enoco Collieries, Inc., Bruceville, Ind.

Vice Chairman: JAMES A. ERSKINE, Electrical Engineer, Eastern Gas & Fuel Associates, Pittsburgh, Pa.

Design of a Power System for a New Mine

F. G. HAMNER, System Planning Engineer, Southern Services, Inc., Birmingham, Ala.

Silicon Rectifiers

RALPH E. WAHL, Senior Design Engineer—D-C Equipment, General Electric Co., Philadelphia, Pa.

Discussion

C. L. SARFF, Chief Engineer, Ireland Mine, Hanna Coal Co., Moundsville, W. Va.

Experience With A-C Mining

OTIS G. STEWART, Executive Engineer, Union Carbide Metals Co., Alloy, W. Va.

Maintenance of Mine Power Systems

A. E. MOLINSKI, Superintendent of Maintenance, Bethlehem Mines Corp., Johnstown, Pa.

Extending Trailing Cable Life

FRANK R. HUGUS, Joy Manufacturing Co., Franklin, Pa., for AMC Committee on Underground Power

WEDNESDAY AFTERNOON—MAY 11

Ballroom—Penn-Sheraton Hotel

1:30 P.M.—Pre-Session Motion Picture
"California and its Natural Resources"

2:00 P.M.—THICK SEAM MINING

Chairman: C. O. KANE, Manager Coal Mines, Armco Steel Corp., Montcoal, W. Va.

Vice Chairman: JAMES A. YOUNKINS, Assistant General Superintendent, Duquesne Light Co., Pittsburgh, Pa.

Conventional versus Continuous Mining Equipment in Seams 38 to 48 Inches Thick

HARRY LAVIERS, JR., Vice President, South-East Coal Co., Inc., Irvine, Ky.

Factors Affecting the Choice Between Continuous and Conventional Mining Machines

W. F. DIAMOND, Manager of Engineering, Island Creek Coal Co., Holden, W. Va.

Equipment Needs and Trends for Mining in Seams Over 48 Inches Thick

E. H. GREENWALD, Partner, Eavenson, Auchmuty & Greenwald, Pittsburgh, Pa.

Productivity of Continuous and Conventional Mining Equipment

R. L. ANDERSON, Commodity Industry-Analyst, U. S. Department of the Interior, Bureau of Mines, Washington, D. C.

Urban Room—Penn-Sheraton Hotel

1:30 P.M.—Pre-Session Motion Picture
"Asbestos, A Matter of Time"

2:00 P.M.—COAL PREPARATION

Chairman: W. D. HAMILTON, Vice President, Olgebay Norton Co., Cleveland, Ohio

Vice Chairman: J. D. SNYDER, Chief Engineer, Blue Diamond Coal Co., Knoxville, Tenn.

Fine Coal Cleaning

(a) With Tables

A. E. COPELAND, Assistant Chief Engineer;

C. W. PORTERFIELD, Director of Research-Testing and Sales Liaison,
and

GUY N. HAYNES, Superintendent of Preparation Plants, Pocahontas Fuel Co., Pocahontas, Va.

(b) With Feldspar Jigs

R. K. BOGERT, JR., President, Badger Coal Co., Philippi, W. Va.

(c) With Heavy Medium Cyclones

J. P. MATONEY, Chief Engineer, Heyl & Patterson, Inc., Pittsburgh, Pa.

Fine Coal Drying

PAUL LEVIN, Project Engineer, Allen & Garcia Co., Chicago, Ill.

Allegheny Room—Penn-Sheraton Hotel

2:00 P.M.—STREAM POLLUTION

Chairman: LARRY COOK, Chairman, Land and Water Use Technical Committee, American Mining Congress

ERNST P. HALL, Research Consultant, Consolidation Coal Co., Pittsburgh, Pa.

HENRY HEBLEY, Research Consultant, Coal Advisory Committee to ORSANCO, Pittsburgh, Pa.

L. E. SAWYER, Director of Conservation, Mid-West Coal Producers Institute, Terre Haute, Ind.

Discussion

7:00 P.M.—SPEECHLESS BANQUET

Main Ballroom—Pittsburgh Hilton Hotel

Toastmaster: ROBERT H. HUGHES, Chairman, Program Committee, 1960 Coal Convention

Brief introduction of honor guests, followed by an outstanding entertainment program

ENTERTAINMENT
and Trips

(*Continued from page 36*)

the Maple Creek Preparation Plant of U. S. Steel Corporation at New Eagle, Pa. This is U. S. Steel's newest coal washer and embodies the most modern innovations in plant design.

A second trip will be made to the eastern Ohio operations of Hanna Coal Company. It will include stops at the Georgetown Preparation Plant and the initial pumping station of the famous coal pipeline, an inspection of the "Mountaineer" stripping shovel, and a chance to observe the land reclamation work being carried on by Hanna.

Entertainment will be "Special"

On the lighter side there will be two gala evening affairs for mining men and their ladies. The Coal Miners party Monday evening will be held in the Ballroom of the Pittsburgh Hilton Hotel. The "fun-packed" evening includes dinner, dancing and an excellent floor show — plus the good fellowship of old friends and new acquaintances.

The "Speechless" Banquet will bring mining men and their ladies together Wednesday evening for another gay time. The dinner will be informal, with dancing throughout the evening. There will be no speeches — only brief introductions of the honor guests, followed by a star-studded entertainment program.

For the Ladies

The ladies, always cordially invited to attend all Convention activities, have, in addition, a program of their own. A most interesting bus excursion to view Pittsburgh's Renaissance has been arranged for Tuesday, May 10. Included will be a ride on the Mt. Washington incline and a stop at the Oakmont Civic Center for a look at the world-renowned International Rooms. A buffet luncheon will be served at the beautiful Longue Vue Club high above the Allegheny River.

Wednesday, honors will be paid to our newest State with a Paikini Hoike — Hawaiian fashion show — following a thoroughly Hawaiian luncheon. Beautiful, authentic Island fashions made in Hawaii and adapted for mainland wear by leading designers will be shown on models from the ranks of Mining Congress ladies.

You Should be There

A broad, well-balanced program, the opportunity to visit with leading Government and industry authorities and outstanding entertainment — all of these ingredients spell out another top-flight AMC Coal Convention. If you haven't yet made your plans to be there, now is the time. Don't miss the industry's most important meeting of the year.

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High Capacity 8-WHEEL BALLAST CAR

This car was designed for a large modern mine. It has four doors which can be individually opened so as to vary the discharge of the ballast to the track.

The large capacity ballast car has enabled this mine to lay and ballast track faster with a smaller man-crew. Car can be furnished in any length, width or height and capacity to suit individual mine condition — comes with automatic or link and pin couplings.

This car has several stake pockets around its outside edge and can be furnished with ends which fold down. Car can be supplied in any length, width, height dimensions or load capacity—comes with either automatic or link and pin couplings.

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Here, one of our teams tests the anchorage capacity of a Bethlehem Roof Bolt assembly. If you're interested in learning more about roof bolts, remember that our men are ready to do a lot more than just talk. They'll help you with the original installation and testing of mine roof bolts and accessories. Just let us know where and when.

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Job-proven to give you *more* . . . in production, performance and service! In "show-down" tests in mine after mine, Cardox bits maintain a lower "cost-per-foot cut or drilled" rating than any other. It's no secret why . . . Cardox carbides are job-matched to meet your specific mining requirements, whether it be drilling or cutting. They are made to uniform quality standards . . . bit after bit, they deliver the same consistently high production output, the same long service life. They make continuous mining more continuous. Want proof? We'll be glad to run a test at your mine. You name the time, place and conditions. Bits available in all sizes and styles.

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You can rely on Airdox Cardox for straight practical answers to your mining problems. We offer you a unique combination of experience, know-how, broadest distribution and stocking facilities, and available qualified underground personnel to answer your needs efficiently, effectively and economically. Call on us . . . where there's coal, there's . . . AIRDOX

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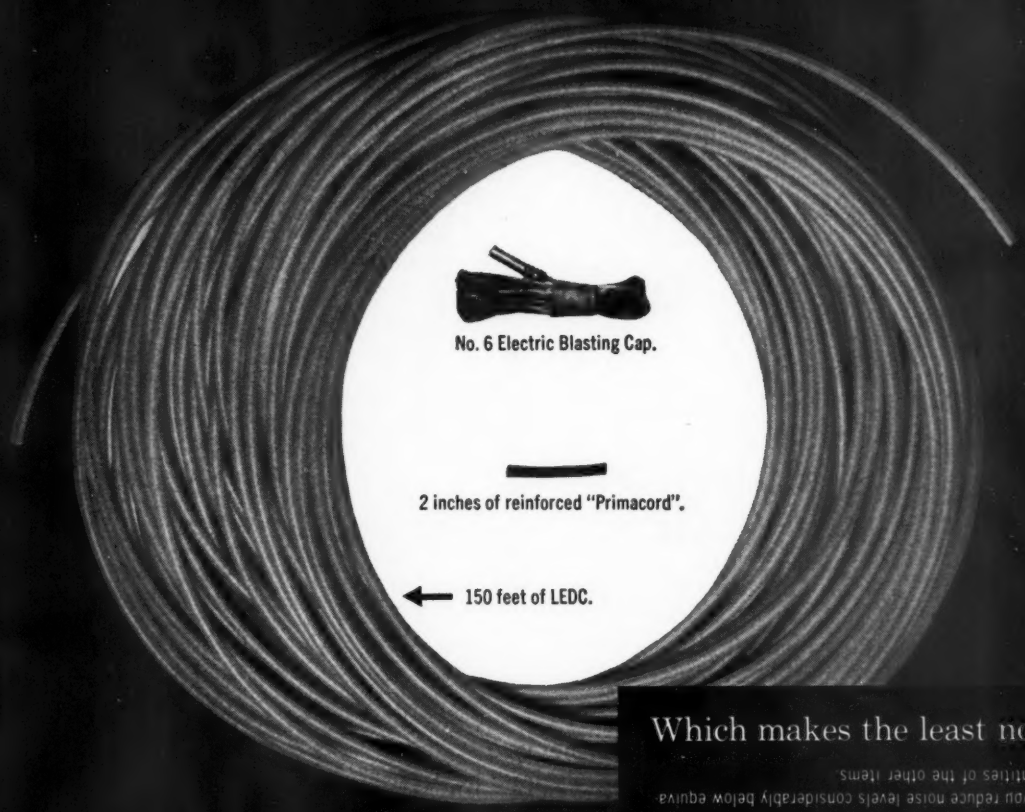

Which makes the least noise?

Answer: All three items produce the same amount of noise. Thus when you use the low noise level trunk line blasting system, you reduce noise levels considerably below equivalent quantities of the other items.

Shhhh!

New Du Pont delay blasting system* hushes the noise of quarry, open pit and strip mine blasting

If you have been burying your "Primacord" trunk lines, or have reluctantly switched to electric blasting caps in order to reduce the noise level of your blasting, here's good news.

Reduces noise The new Du Pont Low Noise Level Trunk Line Delay Blasting System* uses LEDC (Low Energy Detonating Cord) developed by the Ensign-Bickford Company in a cooperative program with Du Pont. It muffles the noise without the nuisance and expense of burying the cord. 150 feet of LEDC makes no more noise than one electric blasting cap!—or 2 inches of ordinary "Primacord"!

2 grains per foot This low noise level trunk line system contains only 2 grains of explosives per foot, as contrasted to 50 grains per foot in the regular "Primacord." It is this tiny load that keeps the noise level down. Our customers report noise and vibration complaints from neighboring residents were actually eliminated, when LEDC trunk lines were recently introduced.

Other features This system uses trunk line delay connectors, available in intervals of 10, 15 and 25 milliseconds. You can select the interval best suited to your particular blasting problem. The low noise level trunk line delay blasting system provides an unlimited number of periods at intervals of 10, 15 or 25 milliseconds. And at no time is it ever necessary to place a blasting cap in the borehole.

Available now Your Du Pont distributor or representative can help you reduce your noise problem with new LEDC at once, or answer your questions about it. Call him. Or write Du Pont, Explosives Department, 6440 Nemours Bldg., Wilmington 98, Del.

**Patent applied for*

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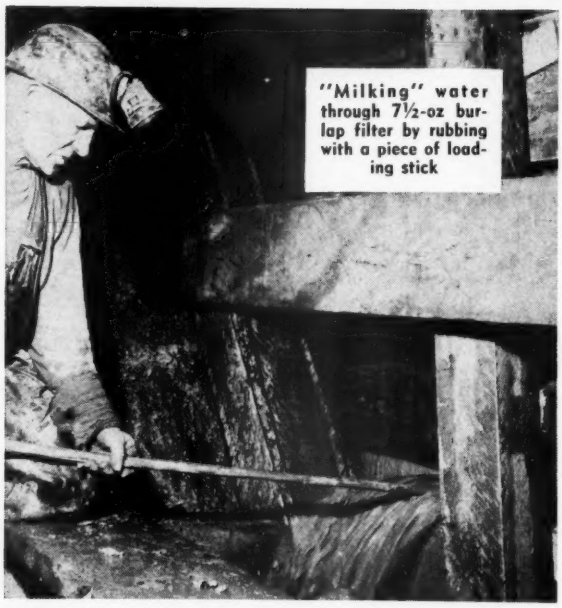
Better Things for Better Living . . . *through Chemistry*

Applications of Hydraulic Fill



"Milking" water through 7½-oz burlap filter by rubbing with a piece of loading stick

Low cost, adaptability, excellent filling qualities and ready availability at most mining operations have made hydraulic fill an important means of support in heavy ground

By JOHN SUTTIE
Mine Superintendent
Mountain Con Mine
The Anaconda Co.

THE Mountain Con mine of the Anaconda Co., located in Butte, Mont., is a copper producing vein mine which has been in almost continuous operation since 1878. The present depth of the shaft is 4968 ft. The company mines five veins which extend to distances of 4000 to 5000 ft from the shaft. The extremities of one vein may be as much as 10,000 ft from another. Veins were formed by replacment along, and filling in, fissures in granite. Faulting and movement have formed soft, broken walls, which extend several feet from the veins and can be supported temporarily by rock bolts.

Vein widths vary and will pinch and swell from a minimum stoping width of two or three ft, to as wide as 35 ft. The average stope width is from 8 to 12 ft, with an average dip of 50° to 60°. Rock temperature on bottom operating levels is 135° F, and air conditioning plants are used to cool air for efficient working conditions.

Fill Characteristics Important

Hydraulic fill is the Mt. Con's main source of fill for stoping, although minor amounts of development waste are also used where development headings are long distances from the shaft and there are stopes suitable for waste fill close to the heading. Hydraulic fill is defined as mill tailing classified either naturally or mechanically to supply a filling material which, mixed with a suitable percentage of water, can be transported through a pipeline and deposited in an underground excavation for the purpose of supporting ground. A desirable type of tailing for stope filling is one with a good percolation rate, which is defined as the rate at which water will drain through tailing. This

Tailing lines are run out so the fill discharges against the endline and water runs back to the filter wall and is drained off. Tailings are placed at a rate of 100 to 150 tph

is the main consideration in selecting material for hydraulic fill, since it governs the speed with which water can be removed from the stope. Rapid water removal is vital in order to avoid possible build up of hydraulic head.

In Butte naturally classified material from an old tailing pond in Anaconda is used. The pond has been sampled, and areas containing tailing with a percolation rate of at least four in. per hr have been staked out. This material makes satisfactory stope fill. The tailing is loaded into hopper bottom railroad cars and is delivered to a tailing plant. There it is washed out of the cars with high pressure hoses into an agitating tank. It is then pumped to the shaftline of four-in. rubber-lined pipe and is dropped to the 4200 ft level where it is distributed through four in. rubber-lined pipe to mining areas on the 4200, 4400 and 4500. The amount of water used to wash the tailing from the cars varies with seasonal changes and causes the percent solids to vary 15 percent. It is planned to keep the amount of solids in the slurry at 60 percent by weight.

Barring down in a hydraulic fill stope

Support of Cut-and-Fill Stopes

The main application of hydraulic fill for ground support is in the principal mining method at the Mt. Con —untimbered, hydraulic cut-and-fill stoping. It is based on the principle of fast extraction of horizontal cuts 10 to 12 ft high and 50 to 100 ft long, temporarily supporting the back and walls with rock bolts, and then filling the void with hydraulic fill. The altered wall rock requires close support for stabilization and the tailing penetrates and fills even small cracks.

Tailing fill placed with water offers much greater resistance to compression than dry sand or waste rock and is much more satisfactory in providing permanent wall support. An example of the compaction of the fill is shown by the fact that a six-ton loader has been operated on regular hydraulic fill.

Tailing lines are run out into stopes so the fill discharges against the endline and water runs back toward the filter wall and is drained off. This prevents build up of hydraulic heads, which cause leaks and breakouts around the filter wall or in cracks and seams in the altered walls.

The entire stoping operation is planned for speed, and hydraulic fill, which places 100 to 150 tons of tailing an hour, is an important part of the stoping cycle. Frequently a stope is filled in the early part of the shift and a brow round is blasted on this fill at the end of the shift.

The tailing line is installed from the top of the broken ore pile as the cut is advanced. It is then used as an air line by connecting the three-in. fill line with an adapter hose to the two-in. air line in the manway. This supplies good air pressure for drilling, as sometimes two machines are used on the breast, and eliminates extra hoses. Since stopes vary in length from 50 to 100 ft, good air pressure and elimination of vulnerable hoses is important.

Six-ton loader operating on regular hydraulic fill. Tailing fill placed with water offers greater resistance to compression than dry sand or waste rock and is therefore more satisfactory in providing permanent wall support

Installation of Filter Walls

Careful attention to detail on filter walls enables us to use simple, easily installed walls. A good hitch should be dug two ft down into the previous fill and new burlap run down it across the bottom of the trench, up the other side and out along the fill. The hitch is then filled and tamped with tailing. Seven and one-half oz burlap is used so that water can be easily filtered; thus water does not build up behind the wall, and the danger of hydraulic pressure causing breakouts is avoided.

The amount of expansion room it is possible to leave between the fill and the ore has a direct bearing on the speed of mining the next cut. Where walls are good five to six ft of expansion room are left. This gives good space to break to and after a blast only a relatively short slushing period is required before drilling can be started. If walls are poor and require maximum support, the space is filled much closer, in some instances tight to the ore. This slows the cycle as more holes are required and it is necessary to slush more ore before drilling can be started.

Other means of speeding the stoping cycle are: rock bolts for quick temporary support and simplified slushing; push feed drills; long steel and smaller diameter tungsten carbide bits to shorten drilling time; sticks of powder 16-in. long to shorten loading time, millisecond blasting to help reduce holes and powder needed and to give better fragmentation, thus speeding up slushing; increasing horsepower of slushers and size of buckets to the maximum practical for operation from development raises; emphasis on slushing out as much broken ore as possible while the cut is being taken across the stope to reduce to a minimum the critical period when only slushing can be done.

Mining in Heavy Ground

Certain stopes, or sections of stopes, require timber support as the ore, walls or both will not hold up with only the support of rock bolts. These stopes are also mined as quickly as possible so hydraulic fill can be run into the void, thus reducing further wall movement to a minimum.

When a vein is wide and cannot be held by rock bolt support, the stope is split in half along the strike, and the hanging wall half is mined first. A normal cut is taken along the hanging wall and gob fence placed against the ore remaining on the footwall. This consists of stulls stood at regular intervals with their tops against the back and their bottom resting on the previous fill. These stulls are cabled to the hanging wall rock bolts, and two-in. gob lagging is nailed to the stulls to hold the tailing when the footwall half is mined out. Successive cuts are mined until the vein width narrows so that the full width can be mined in one cut. Then the half left on the footwall is mined. This footwall portion is mined using a lower back than the hanging wall cut, so that the top of the stulls lay against the footwall ore, giving a solid support to help hold the tailing and thereby not relying solely on the cables.

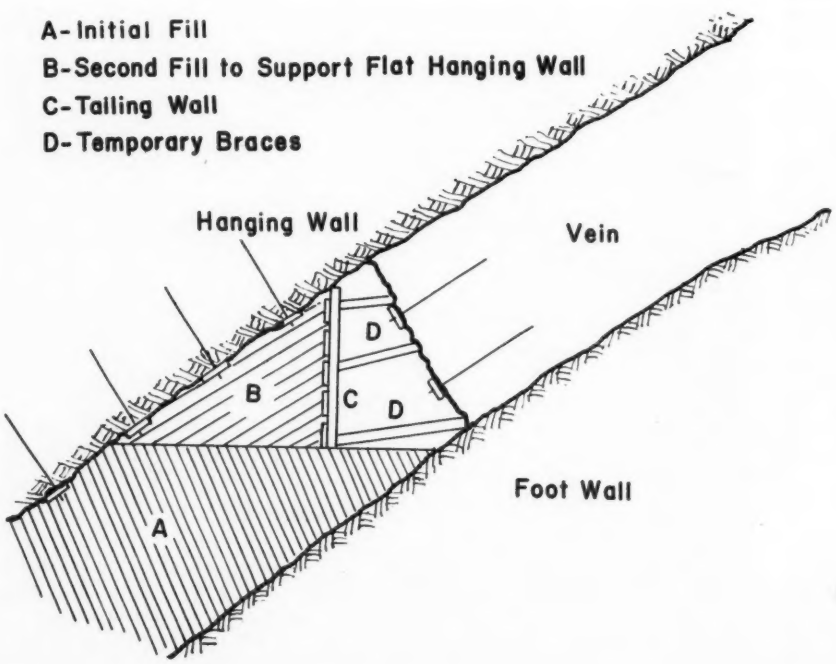
In flat dipping veins the back of the stope is carried at right angles to the footwall. This exposes extra lengths of unsupported hanging wall that tends to break up causing dilution and dangerous working conditions. To remedy this, we run our regular fill, then build a filter wall along the hanging wall and fill this section before mining the next cut.

If it is necessary to use hydraulic fill on top of a waste filled area, the area is leveled and covered with several layers of burlap. Then, small amounts of tailing, with the least amount of water possible are run until a good base is established over the waste fill. It is important to keep water to a minimum and drain it off through a filter wall as soon as possible to reduce the possibility of leaks developing.

Ground Stabilization

Where voids from previous minings have caused ground movement resulting in the crushing of sill timber, these areas have been stabilized with tailing. Broken timber is replaced, the outside of the gob lagging is burlap, tailing is introduced over the sill by running feed pipes up into the high points, and the water is drained out through mousetraps, which are burlap-covered, perforated water boxes or pipe. Short runs are required in this process to keep the hydraulic head down to a minimum. When the sill area has been filled, voids above the sill can be filled by running tailing down from the level above, again in

(*Continued on page 56*)



Method of mining a flat vein using hydraulic fill

Control of Air Blast Effect

Resulting from Blasting Operations

By J. R. KRINGEL
Vice President—Production
New York Trap Rock Corp.

To avoid further economic loss and to overcome some of the problems resulting from blasting in thickly settled areas, New York Trap Rock has devised several field proven techniques for reducing noise and air blast propagation

"IN typical open pit or quarry operations, the problem of damage from air blast is insignificant." This statement, or words having the same meaning, appear as conclusions in summary reports of the Bureau of Mines[1] and all other groups which have addressed themselves to this line of research.

Some of us in my company, however, have put a cost tag of $86,000,000 on the effects of air blast from blasting operations, with perhaps a small part of the bill chargeable to a culprit slightly higher on the frequency scale and more persistent—noise. Perhaps another small charge to inadequate public relations would be appropriate.

In deriving this interesting dollar figure, a little background information is necessary. New York Trap Rock operates four stone quarries on or near the Hudson River within 60 miles of New York City. The company currently supplies to this area market annually some 7,000,000 tons of high quality crushed and graded aggregate, riprap, and by-products, most of which are delivered by a fleet of company-owned deck scows. Motive power for these scow fleets is supplied by tugs from a wholly-owned subsidiary towing company. The minerals are diabase, produced at two quarries; and dolomite, from the remaining two.

110 Primary Blasts Fired Per Year

In the process of achieving this production, an average year requires 110 primary blasts averaging 19,000 lb of explosives each. Drilling and blasting are largely by conventional means. The company has only a few gimmicks that may be unconventional, which will be touched upon later.

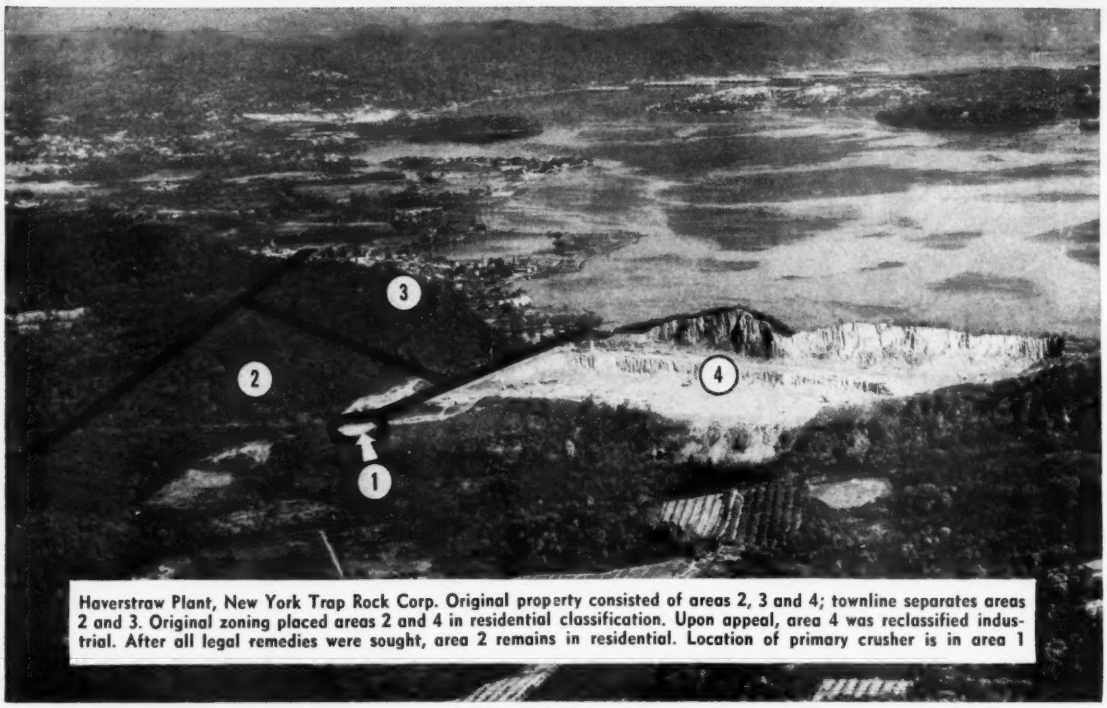
The point of departure from the normal happy and rewarding routine of developing blasting methods which will provide proper fragmentation for sometimes too-small primary crushers, at suitably low unit costs, is this: all operations are located in or very close to residential neighborhoods of medium to high value homes. Further, over the years, these areas have become more and more thickly settled as highway vehicle capacity leading to New York (built, it might be added, with Trap Rock materials) has been increased. The exodus from the city has become a flood, and the company's three lower plants now operate in what is virtually New York City's bedroom.

In deference to its status as a neighbor, the company has over the years explored all of the known and some unknown techniques of reducing our nuisance value. Blasting, of course, has been the principal intruder into the consciousness of those neighbors who fled the city and settled down in the sylvan quiet of our section of exurbia.

As an example of the efforts which were put forth by the company, the electric blasting timer, later taken over and refined by Du Pont, was developed by Trap Rock engineers. This device was the original means of securing millisecond delays between the individual holes of large open-pit primary blasts in operations such as our own, where for safety, electric caps were not used for initiation within the holes. This development was undertaken primarily with the intent of reducing vibration; the improved fragmentation only came as a corollary bonus.

Seismograph Records Shots

The company is one of the few open pit operators which owns its own portable seismograph, and retains a full-time employe qualified to operate it and interpret its indications. Since 1946 seismograph readings have been taken on every primary blast, and on some of the secondary blasts which have been fired, a total to date of over 1000 seismograph recordings. These have been recorded together with the size and location of the blast, distance away, and rather complete weather data. Since that time the number of com-



Haverstraw Plant, New York Trap Rock Corp. Original property consisted of areas 2, 3 and 4; townline separates areas 2 and 3. Original zoning placed areas 2 and 4 in residential classification. Upon appeal, area 4 was reclassified industrial. After all legal remedies were sought, area 2 remains in residential. Location of primary crusher is in area 1

plaints resulting from each blast has likewise been logged.

Prior to this, the company operated a Vibragraph, taking 900 recordings from 1931 to 1946. Before that, the old pin sets were used. Records are kept on all details of loading, priming, burden, spacing, stemming and delay intervals. In addition the seismograph traces are measured, and from them the damage index, in terms of Crandell's[2] Energy Ratio, is computed.

Blasts seldom produce seismic vibration energies of more than one-tenth that considered damaging to reasonably well built structures, and over a period of years have never equalled or exceeded the damage criterion. Through seismograph data, the company's blasting techniques have been improved in terms of emitted seismic vibration.

Understandably, since it is freely conceded that the other side effects of blasting, namely noise and air blast, are not, under conditions such as ours, physically damaging, our emphasis was almost entirely directed toward seismic vibration. In fact, we had been rather smug and comfortable in the thought that our damage potential was virtually zero, that in fact, no court in the land having due regard for expert testimony could possibly hold that we had in any way contributed to the destruction of a neighbor's house, his goods, or his wife's delicate bric-a-brac. We, other operators in similar situations, the powder companies and most of the experts in the field were of the opinion that once having arrived at this ideal state of vibrational affairs, our troubles were over. Were they? Far from it!

Blasting Brought Complaints

Complaints continued to come in following blasts, even increased in number. Movies and pamphlets designed to show the householder that properly conducted blasting operations were incapable of causing the cracks in his foundations and plastered walls were not convincing. Nor did he believe that there are 40 other recognized reasons why cracks appear in houses. Personal contact helped some, but not in terms of real persuasion.

When Trap Rock personnel were present in some of these houses by pre-arrangment during a blast, the almost invariable comment was, "This was nothing, you should have been here for the one last week!" On one occasion, the "one last week" consisted of 70 lb of 40 percent dynamite in a seam shot, while the shot involving the company observer consisted of 21,000 lb of nitro-carbo-nitrate blasting agent in 12 primary holes at 26 millisecond delay intervals. Always, the complaints include a recital of how "the house shook, the windows rattled and dishes rattled in the cupboards." Frequently, the floor rocks and the house moves on its foundations. On one occasion, a kitchen ceiling lifted six in. so that daylight could be seen at the top of the wall; on another, a lady enjoying a leisurely bath found herself high and dry when one of our blasts tossed the water out of the tub. At least one of these tales was sworn to in court; all were impossible according to our instruments.

Quarry Property Zoned Residential

At one stage, a town government in adopting zoning, placed one of the company's operating quarries in a residential classification. The quarry had then been operated for over 12 years, and investment in the property and plant was about $3,000,000. Who or what inspired this apparently senseless attack on one of the town's major taxpayers and job providers? It was a very small group, largely neighbors, part of whom felt that we were a landscape-destroying scourge; most feeling as well that the operations were destroying their property —if not physically, at least in terms of value.

During the course of the hearings on this zoning as well as the appeals which the company made later, much testimony was taken which was largely concerned with the allegedly destructive features of blasting. It seems that zoning has become much more than a simple design for land use. In a small town, it is not unlikely that some of the members of the zoning board of appeals, or their close relatives, believed that their properties had been damaged.

The original zoning position was so untenable that the board of appeals had to make restitution, which they did, of sorts. It happens that a state road cuts through this property, and while the area of the operating quarry, including the mill, south of the road was restored to the company, about 40 acres north of the road were left in residential zoning, with quarrying forbidden.

This decision was appealed through three levels of jurisprudence in New York State, only the lower court holding that the company had any rights in this block of mineral bearing land. The higher courts went along with the contention that the State Road made this block non-contiguous with other holdings. Question: "At how many locations must you attack a mineral deposit to establish prior rights to your reserves?"

In some states valuable mineral rights may not be tossed about with such abandon: they are recognized as national resources of consequence to the public. Even from this enviable position, though, it must occur to the reader that this thing which happened to Trap Rock amounted to literal condemnation without due compensation for the values involved. Company officials thought that the Supreme Court of the United States might see a constitutional issue in this case, but this they failed to do.

Life of Operation Cut 12 Years

Now, as to what was lost. In this "residential" property there are 35,800,000 tons of marketable product, representing sales revenue of almost $86,000,000 at present prices. This lost tonnage shortens the life of this operation by at least 12 years. The tax loss to the town will be in the neighborhood of $400,000. In addition, despite legal contentions sustained in court, the property is virtually worthless as residential land, most of it rising in a steep slope besides being very rocky and lacking in topsoil.

It is my opinion, perhaps not wholly shared by all of my colleagues, that had there been developed that theoretically perfect explosive in which the entire energy release was devoted to the shattering of rock without a single dyne left over to escape in the form of air blast, noise, or vibration, and had we been using that explosive, this calamity might not have befallen us.

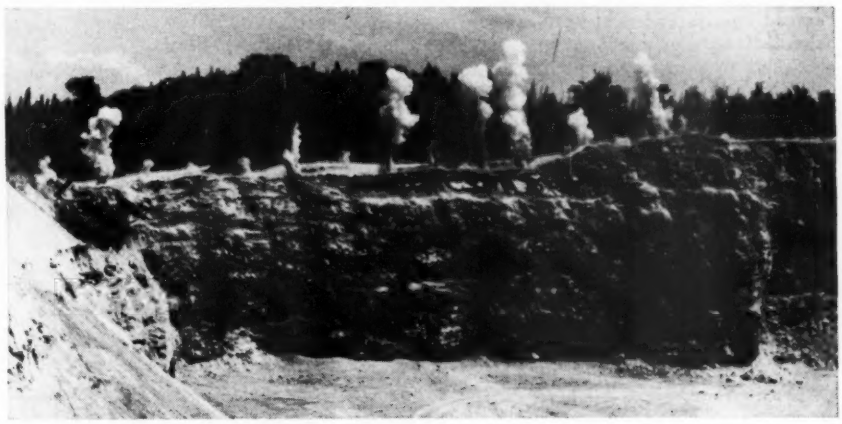
We have made ourselves very unhappy over the years, pondering the deceit of our fellow beings and neighbors. It is significant that many of the people who seemed addicted to these blasting fairy tales were otherwise rational persons, ranging in occupation through the professions, including engineers. Some of the company's own people, after calling on complainants over a period of time, themselves became shaken in their faith in our technology.

The entire problem had become both pressing and stubbornly resistant of resolution. For us, it was sheer frustration. Three years ago, perhaps unconsciously, we changed our orientation. Instead of relating complaints to vibration alone, which led only to more frustration, we began with the complaint as the central factor, and began a statistical review of complaints versus each of the many data which had been recorded for each blast and seismograph reading. In the course of a year, it was concluded that there was absolutely no correspondence between number of complaints and any of the blast data, recorded weather data (including overcast conditions), foliage on the trees or lack thereof, nor most particularly with *the amplitude of frequency of seismic vibrations!*

Public Relations Staff Employed

Meanwhile, the company had employed a full-time public relations staff, and while their efforts certainly contributed measurably to the esteem in which the company was held by the communities, perhaps may have reduced the number of complaints by a fraction, still the complaints came in uncomfortable numbers. In the meantime, also, the company had begun to work hard on the long-acknowledged but hitherto somewhat-brushed-over fact that people were confusing air blast and noise with vibration. Convinced of it ourselves, Trap Rock failed miserably to convince people that both air blast and noise, as we caused them, were harmless, and that air blast from primary shots amounted to little more than isolating a sudden puff from a 25 knot breeze and flinging it, as it were, against their houses. "It startles you when the windows rattle," we said, "but it really is harmless." We cited the Bureau of Mines which had determined that a pulse pressure of one to two psi was needed even to break glass, whereas, the Bureau had observed maximum pressures from ordinary quarry blasting produced only pressures on the order of 0.01 psi at ranges of 400 to 1600 ft from the blasting site.[1] This may have impressed some persons, but it convinced none. We failed to persuade more than a handful that the house, in fact, was not rocked by our blasts.

Finally, one fine day, a 24,241 lb shot was set off. It consisted prin-



A typical well-planned, well-controlled blast. An average of 19,000 lb of explosives is used in each primary blast

cipally of ammonium nitrate prills in 17 holes delayed 15 milliseconds between holes with a maximum in one hole of 2036 lb. Everything was done in fairly usual fashion; powder factor may have been a bit high in some holes, a new type of delay may have been a bit off time, burden may have been a bit light here and there, but it was a routine shot, and the seismograph showed nothing wrong. Yet, before the dust settled, plant telephones began to jump off their hooks, and before the day ended more than 22 complaints had been registered. We had long since resigned ourselves to the fact that there were a few persons in each locality who, for diverse reasons, complained as a matter of habit or principle; but in this flood there were many who had never complained before, and who were known friends. One, a professional engineer, who had recently been appointed to head the town zoning board, avowed that this was the last straw, and that when the new zoning ordinance was drawn up, there would be ample restrictions to insure against our "blowing the whole town down." All of the new callers had, of course, found new (to them) cracks in walls and foundations. Within a few days, some insurance adjustors had made settlements, some of which wound up as subrogation suits against the company.

Vibration Versus Air Blast

One of the settlements was made in a location over a mile from the quarry. Intervening is a hill rising some hundreds of feet. It was clear that the injured party sincerely believed that his home had been severely shaken, and there was no doubt that he had felt a severe air blast. From the dozen or so dwellings between him and the quarry, there were no complaints. All who complained were unshaken in their belief that the ground shook as in an earthquake, yet the company's seismograph, only 1600 ft from the shot, indicated a resultant vibration amplitude of less than 0.005 in. The energy ratio at that range was computed to be one-thirtieth of that required to induce structural damage. According to all available data on human response to vibration, it should have been barely perceptible via one's shoe soles at the seismograph location; and due to attenuation, not at all perceptible at the mean range from which the complaints came.

This day compelled us to face squarely the issue of sincerity on the part of those who complain. We had, as previously mentioned, long felt abused by our neighbors' apparent disregard for the truth in the tales they told about our blasting. We had rather loosely categorized the majority as crackpots who did not want to listen to reason. We had chosen to mistake their concern over something which they honestly believed was dangerous and damaging, for unreasonable animosity toward the company.

This latest group had largely been friendly toward us. Scratch animosity. Why then were we not able to convince them that what they had experienced was severe air blast effect, which could shake neither them nor their houses? Why was this confusion between vibration and air blast impossible to resolve?

Reactions to Air Blasts

The answer to that one came out of the blue. By the luck of the draw, while attending a seminar in New York City, completely unrelated to blasting or quarry operations, the writer wound up seated next to Dr. H. O. Parrack, whose name tag indicated that he was with the Air Force Air Research and Development Command. It developed that he was a neuro-physiologist whose mission with the Air Force was to cope with the twin problems of vibration (in air) and noise which have become increasingly troublesome with the increase in number of jet airplanes.

With the aplomb of a fellow professional, I said to him, "It beats me how otherwise intelligent people can mistake a puff of wind for an earthquake; how they can imagine that the ground is shaking just because the windows rattle." His counter to that one was short and to the point, "My friend," he said, "they don't imagine it, they *feel* it!" His reduction of his science in terms understandable to me was a model of analogy. Likening the brain to an electronic computer, he made the point that no response could be had from such a complex mechanism which did not involve values already incorporated in the memory section of the unit. In the case of the brain, experience is the programming section of the computer. "Within the experience of the average person," he asked, "what may cause windows to rattle? Certainly wind, on a windy day, but what about a calm, sunny day when the leaves are still? Bear in mind that the brain, charged with physical balance and all other motor functions which protect the main organism, not only has to evaluate according to the stored information of experience, but also has to initiate instantly the signals which will bring about the required protective reaction. Now, as to the calm day and the windows, the quickest answer is that a shaking of the structure will cause windows and dishes to rattle, and in the absence of any other quickly identifiable causative, the message from the computer to the physical control centers in the rest of the body is one of warning and standby to meet the expected instability of footing. Perhaps some leg muscles tense in anticipation. Perhaps some adrenalin is

Records are kept on all details of loading, priming, burden, spacing, stemming and delay intervals. Since 1946, the company has also recorded every primary blast and some secondary blasts by means of a seismograph

released against sudden need. Carrying the analogy further, the nervous system now resembles a servo-mechanism in which the order has been transmitted between the master unit and the slave units, and the slave unit has returned its feedback message to the master. Reactions have taken place and have been reported back to the brain, which so nearly complete the process of actually compensating for unstable footing that the minute distinction is lost; the house did shake, according to the computer. Meanwhile, the slower remainder of the system catches up and reinforces the picture with feelings of fear, resentment, and outrage over the intrusion."

I buy this in its broadest implications, and if I have a message, it is simply this: When your human engineering problems reach an impasse, *check your own premises.*

Reducing Complaints

The technical end of this whole business is really the simplest, in retrospect. The goal is well defined: reduce noise and air blast and you reduce complaints.

In the noise department, Primacord trunk lines, caps, and connectors have been the chief source of "explosive" noise. Covering them with sand or stone screenings even as deeply as 18 in. has been only partially effective. Use of the recently developed LEDC (Low Energy Detonating Cord), which is a well-sheathed Primacord having a powder train weight of one grain per lineal foot, compared with the formerly used 50 grain cord, has reduced the "snap" to what we consider an acceptable level. Fewer people "hear" the blasts now, and LEDC does not have to be covered.

Much closer attention to powder factor in individual holes, lighter loading of decks, and the improved control of burden and spacing have probably reduced our production of air blast. Possibly these are offset by the greater production of gas through our extensive use of ammonium nitrate prills. There is no easy measure, and little control.

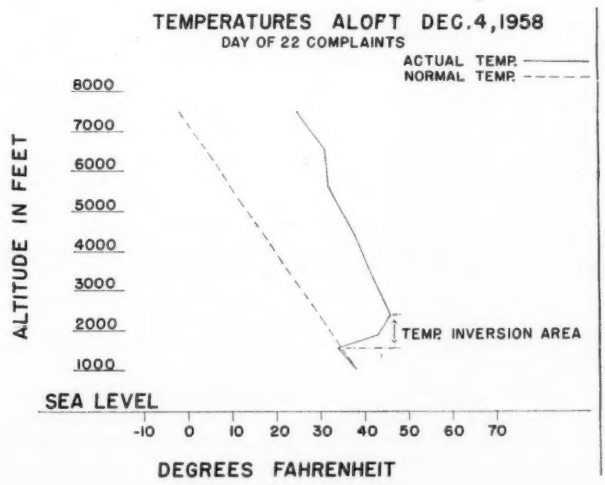
It is in the control of propagation of air blast where it is felt Trap Rock has made significant strides. Following the day of the big boom, it was concluded that the difference in the complaint score between one blast and another had to be attributed to atmospheric conditions, at that time beyond our ken. In researching the atmosphere situation, it was disclosed that on the fatal day, there was a temperature inversion of 15° F in an altitude range of 2000 to 3000 ft above the quarry, which is near sea level. One of our people, based on some knowledge of the behavior of underwater sound, has suspected that temperature anomalies had something to do with the matter. This stimulated further delving, and in checking back to other days when complaints were abnormal in number or vehemence, it was discovered that inversions or isotherms were invariably present in the lower atmosphere.

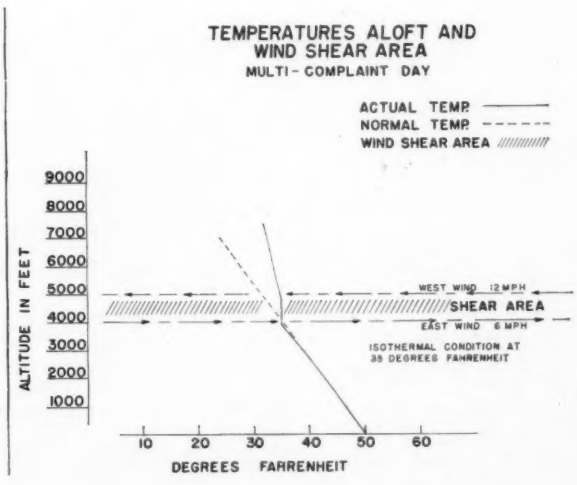
Isotherms and Inversions

To define the terms, in the meteorologists' so-called "standard" atmosphere, the air gets colder at altitude, having a lapse rate or temperature drop of 3.5° F per thousand feet. The lapse rate may vary, and under certain conditions over a range of altitude, may be zero. In this instance, an isotherm exists. Under more extreme conditions, at certain levels, the air may actually become warmer as altitude increases, creating an inversion.

Much unnecessary delving into acoustics and meteorology was done to arrive empirically at the conclusion that atmospheric temperature conditions seriously influenced the company's blasting problems. These things have been known for a long time as evidenced by the writings of Warren W. Berning of the Army's Aberdeen Proving Ground,[3] Dr. Melvin A. Cook,[4] and the United States Weather Bureau. The latter agency, long after we had gone through the process of deduction, quite casually mentioned that before the days of the radiosonde balloon, it was their practice to set off explosive charges, and by triangulation based on the timing of the reflected sound wave, to compute the altitude of atmospheric temperature inversions. Like so much other useful information, the material in these sources remained unused until someone undertook research on the subject on almost a desperation basis.

Air blast effect and sound, through atmospheric refraction and reflection, may be focused, and magnified in intensity even beyond the overcoming of the normal attenuation due to their passage through the air, which explains why a location remote from the blast site may record relatively severe air blast while another in the immediate vicinity of the shot may suffer little or none. These phenomena are





explainable and predictable through the application of known principles of physical science. Berning's paper[3] is excellent background for those who would understand more of the basis of these effects.

[Since this article was written, rather substantial evidence has been compiled, which indicates that an atmospheric condition known as wind shear may have a marked effect on the reflection or refraction of sound in a manner similar to that observed in the presence of temperature anomalies. Wind shear is defined as a condition wherein within a very narrow range of altitude, wind direction or velocity undergoes a marked change. This phenomenon is well known to meteorologists, and particularly to meteorologists dealing with flight operations.]

Unfavorable Firing Conditions

You need not be a physicist nor a psychologist, nor even a meteorologist to reduce your blasting complaint score. On a working basis, such other atmospheric conditions as affect sound and air blast propagation, humidity for one, we do not presently believe to be influential to the basic problem. Hence, on days when isotherms or temperature inversions exist or are likely to develop, blasting is kept to a minimum. Meteorologists can predict these conditions with good accuracy, and while some Weather Bureau stations have not time nor staff to provide this specialized type of prediction, there are private meteorologists who may be employed. We use one of these. Normally we can get a forecast early enough to postpone loading a shot until conditions show improvement. On occasion, firing of a loaded shot has been delayed until an inversion cleared up, which they frequently may within a few hours. This policy has not seriously disrupted blasting schedules or production, although the stakes are large, and some penalty would be accepted, if necessary.

We are working on more exact values, but it is our opinion at present that inversions or isotherms which exist at altitudes above 6000 ft do not create unfavorable firing conditions under our blasting practices. It is also believed that ultimately some values may be assigned to inversion temperatures and to the vertical extent of isotherms below which no dangerous potential exists.

Rules of Thumb Stated

Lacking forecasts, certain weather manifestations indicate unfavorable firing conditions: that is, possible inversions. Rules of thumb are:

1. An area of relatively high atmospheric pressure which remains stationary over a given location becomes dangerous after the first day of its presence.

2. Large daily temperature variations at the earth's surface indicate unfavorable firing conditions, particularly for morning firings.

3. Poor visibilities and light winds in the early morning followed by cloudless conditions throughout the day indicate dangerous propagation of air blast.

4. Light surface winds and low relative humidity at ground level plus the presence of stratified cloud deck below 10,000 ft indicate dangerous firing conditions.

We are getting results. With blasting activity for one period in 1959 increased by 43 percent over the same period in 1958, complaints over the equivalent periods were reduced to one-third of their former level. In 1958, 105 primary blasts resulted in 123 complaints, whereas in 1959, 130 primary blasts resulted in 39 complaints. The maximum number of complaints about any given shot has been three as opposed to six, seven, eight or more in previous years. Deducting the complaints which come to be classified as "chronic" and therefore unreliable as gauges of true effect, the irreducible minimum is in sight.

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APPLICATIONS OF HYDRAULIC FILL

(Continued from page 50)

short runs. Open areas around shafts and airways have been stabilized in like manner.

Where it is possible to fill sills temporarily, the cost of the above process, as well as the time involved in placing small fills, has been eleminated by filling the entire area and then removing the tailing from the haulageway.

Method of Extinguishing Fires

When normal methods of fire fighting, such as use of water and control of ventilation, have failed and the zone contains enough ore to warrant recovery, hydraulic fill is regarded as the final and positive method of extinguishing the fire. It also provides ground support which facilitates future mining. A thorough knowledge of the area is necessary to confine the filling to the smallest practical area. Reinforced concrete bulkheads are planned and an estimate made of the tailing required to fill the area. Bulkheads are placed and hydraulic fill is run into the zone.

For fire work, tailing containing variable amounts of minus 200 mesh material should be available.

Coarse tailing is run first behind bulkheads to assure good drainage and to fill sills. Finer tailing is used to stabilize tight gobs. Tailing is usually introduced at the bottom of the fill zone and forced upward through the gobs until they show on the level above. Water is drained out at certain bulkhead positions and carefully controlled to avoid building up excessive pressures.

A fire is assumed to be out in most cases if smoke and active fire gases disappear, the oxygen content of the enclosed air is less than six percent, carbon dioxide is greater than ten percent, and exhaust air temperatures are not in excess of normal ground temperatures over a period of several weeks.

Another use for hydraulic fill in its role as ground support has been practiced at Butte in the form of hydraulically filled large mined-out areas preparatory to development for block caving. This practice has had the additional advantage of eliminating the hazard of known or potential fire zones.

In conclusion, hydraulic fill, due to its ready availability to most mining operators, its cheapness, varied applications, and excellent qualities as a filling medium make it a very important means of ground support in heavy ground. Applying hydraulic fill for ground support at the Mt. Con mine has enabled this fundamentally high cost operation to reduce costs and remain in production instead of being shutdown.

Conventional Versus Continuous Mining Equipment in Seams 38 to 48 Inches Thick

With two years of continuous mining under its belt, South-East Coal Co. has achieved greater productivity, a better final product, lower maintenance cost, and the ability to greatly reduce the amount of development work needed for a given production

By HARRY LAVIERS, JR.
Vice President
South-East Coal Co.

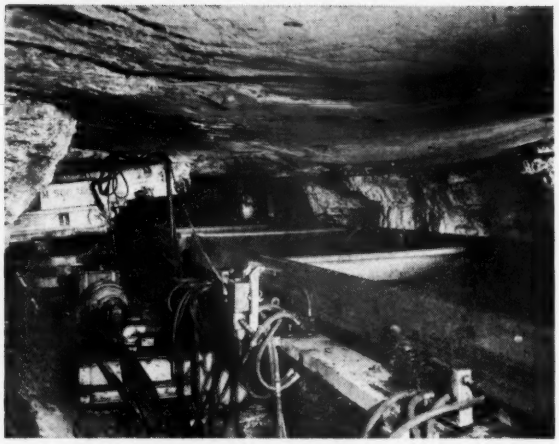
SOUTH-East Coal Co. operates three deep mines in the No. 3 Elkhorn seam of Letcher County, Ky. In 1959 these three operations produced approximately 850,000 tons of coal. Production comes from six Lee Norse CM33X continuous mining machines and one Joy Super 14BU conventional section. The two larger of these mines were put in operation shortly before World War I. They progressed successively through hand loading, duck bills and conventional off track mining. In October 1956 the first continuous miner was installed on a test basis. Eighteen months later the decision was made to convert all production to continuous mining machines. This change was substantially completed by June 1958. This means that the company has now had approximately two years experience with continuous mining. It has learned and unlearned a lot in these two years.

Production Per Man Upped 67 Percent

Rather than repeat here a detailed analysis of the company's mining sequence, this article will cover some of the unusual facts that have been brought to light in the two years with this new type mining. Probably the first objective any company has in mind when it installs continuous mining machines is to increase its production per man. South-East's machines definitely did this. With conventional mining in 1956 an 11-

In switching from conventional to continuous mining equipment, South-East Coal Co. found that the cleaning plant product contained a smaller percentage of 3/8 in. by 0. Apparently the continuous mining machine produces these small sizes of coal with less fine production than the crushers in the cleaning plant were doing

The biggest reduction in maintenance cost was in trailing cable. Continuous mining machine cables last from 20 to 30 months. This contrasts with a life of two or three months for mobile loading and cutting machine trailing cables



High production from a small area makes it convenient to put high quality track to one or two locations rather than to use a lower standard in several locations

man crew averaged 300 tons per machine shift. In 1959 the six-man continuous miner crew averaged 325 tons per machine shift. This is an increase of 25 tons per unit and an increase from approximately 30 tpd per man to 50 tpd per man.

The continuous miner crew consists of a miner operator, a timber man, two shuttle car men, a repairman and a section foreman. Because section foremen are salaried personnel, this change means that the percentage of total employes who are on salary has greatly increased. In this and other ways the company finds that its continuous mining machines have greatly increased the fixed overhead. In addition to changing the ratio of monthly men to day men, this reduction has materially altered the ratio between production men and non-production men on the company payroll.

At many mines the installation of continuous mining machines has seriously overloaded the fine portion of the company's cleaning plant. In South-East's case this was not true. Prior to the introduction of continuous miners, the run-of-mine coal passing through a 3/8-in. round hole screen was approximately 22 percent. Today this percentage is nearer 26 percent. However, South-East markets most of its coal in sizes smaller than two-in.

Coal, as it comes from the cleaning plant, actually contains a smaller percentage of 3/8-in. by 0. This is attributed to the fact that the continuous mining machine produces more coal smaller than two in., hence, less crushing has to be done in the cleaning plant. Apparently, the continuous mining machine produces these small sizes of coal with less fine production than the crushers in the cleaning plant were doing.

A rather unusual change has been noted in the 3/8-in. by 0 coal. Prior to the introduction of continuous mining machines, this coal has a grindability of 53; now the coal is harder, having a grindability of 49, Hartgrove. This change is attributed to the fact that the coal does not now contain the incipient fractures which were present when the coal was blasted. It is also believed that this same situation has occurred in the larger sizes. This is desirable because it means that the coal has better dimensional stability in transit to market.

There has been no detectable change in the washability of the raw coal. However, there has been a one half to one percent increase in the reject from the cleaning plant. The company attributes this to the fact that a continuous mining machine unavoidably cuts down a certain amount of top rock which is left standing with conventional production.

Biggest Reduction in Cost Was in Trailing Cable

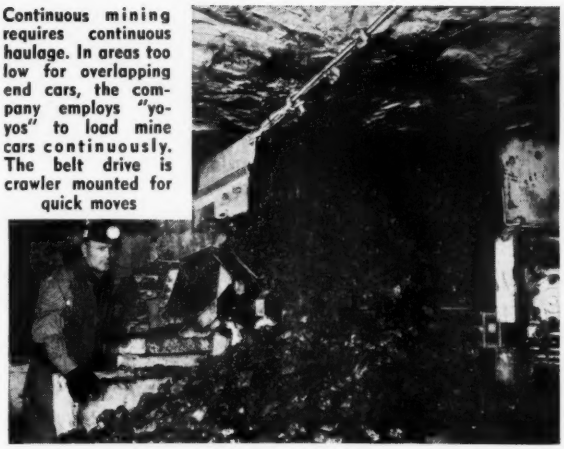
A third important factor has been the maintenance record. On a per ton basis the continuous mining machines have slightly reduced maintenance costs. They have, however, materially altered the source of maintenance costs. Bit cost has turned out to be some one or two cents per ton less than shooting costs were. This savings, however, is probably lost in a slight increase in power consumption. The biggest reduction in cost the company experienced was in trailing cable. To date continuous miner cables last between 20 and 30 months. This contrasts with a life of two or three months for mobile loading and cutting machine trailing cable. Over-all this has meant a substantial cost reduction. In addition, a very much smaller amount of maintenance is required on shuttle cars. No doubt, this is due to the fact that the miner does not continually bump the shuttle cars as did the mobile loading machine.

Continuous mining has caused the company to make some very pronounced changes in its methods of mining; not so much in the way projections are laid out as in the way the company employs its manpower.

A major problem was the cost of advancing or retreating the loading points. A conventional 11-man crew could move a loading point 400 ft in about one shift's time. The continuous miner crew in making this move with its greatly reduced personnel sometimes required as much as three shifts. One section crew for one shift on conventional equipment meant the loss of about 300 tons of coal. Three section shifts for a continuous mining crew meant the loss of more than 950 tons of coal. In addition, it became very obvious that a move-up every 400 feet was not adequate. While t me studies on conventional equipment had failed to show a positive correlation between section production and average length of haul, similar studies on a continuous miner crew showed that as the continuous mining machine got further from the loading point, production decreased rapidly. Section belts have now provided an answer to this problem. They reduce the number of moves required by one third and they enable the company to keep the loading point practically at the last open breakthrough.

More Air and Power Required

While not absolutely a result of the continuous miner installation, it was



Continuous mining requires continuous haulage. In areas too low for overlapping end cars, the company employs "yo-yos" to load mine cars continuously. The belt drive is crawler mounted for quick moves

Continuous mining accentuates the desirability of roof bolting. Note the thru-the-steel rotary drill dust collector

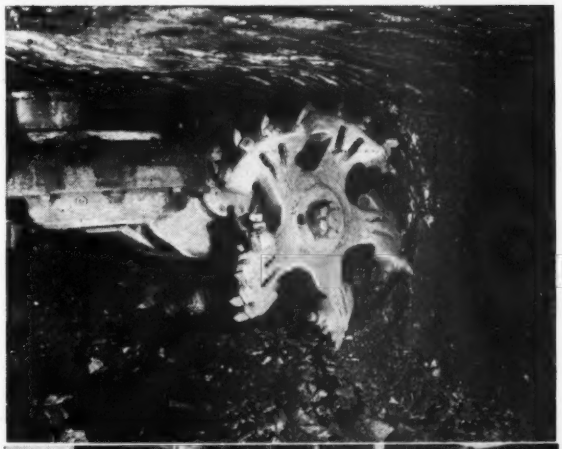
found advantageous once the company had miners to make other changes in the mining system. The ability of a continuous mining machine to produce a large amount of coal from a small mining area has meant that the company has been able to greatly reduce the amount of development work which must be maintained for a given amount of production. In time, this will also amount to a substantial savings in cost. High production from a small area also makes it convenient to put in high quality track to one or two locations, rather than a lower standard over a considerably larger area.

However, this concentration has not reduced costs in all areas. Increased requirements for air and power definitely cost more than with conventional equipment. A continuous mining machine, due to its more rapid advance and high dust production, requires two to three times as much air per ton of coal mined as conventional equipment, and to bring this large quantity of air to a small area is expensive. Likewise, it has been found desirable to bring the 6900-volt primary power much closer to the face than previously. This appears to be more costly than the previous system.

Machine Operator Important— Paces Work of Others

Continuous mining machines have also brought South-East a major problem in personnel. The machines are considerably more complex to maintain and require a correspondingly higher level of maintenance personnel. These people are at the present time in very short supply. On conventional equipment a certain amount of "down-time" could be had on every shift without materially affecting production because each section of the cycle actually had a spare capacity and could catch up after it went back in operation. With the continuous mining machine no such leeway exists. If the machine is down, production is lost forever. Also, the miner operator has been found to be a rather important person on the section. He in effect paces the work of all the other men and if he is not able to get the maximum production from his machine, everyone else on the section is forced to wait.

The company has noticed a ½ to 1 percent increase in the reject from the cleaning plant. This is attributed to the fact that the continuous mining machine unavoidably cuts down a certain amount of top rock



A high level of maintenance is necessary because lost time is lost production

South-East feels that continuous mining will also pay big dividends in safety. Thus far, it has not, but the company still feels that when five men who were previously employed within ten ft of the active face are removed from the mine, the safety record will improve. In addition, the operator of the continuous mining machine need never approach closer than 15 ft to the active face. This coupled with the fact that the machine is so massive it can withstand most rock falls, should greatly improve the safety of the miner operator over that of the mobile loading machine operator.

The potential of continuous mining is just now being touched upon. This increased potential will be an evolutionary thing rather than the revolutionary change which South-East has just experienced.

Special Steels for Special Mining Jobs

By H. J. BENECKI
Staff Metallurgist
Crucible Steel Company of America

STEEL is recognized as the most useful and important of all metals. This is true, not because of any magical properties, but because of versatility—the ability to meet a wide range of property requirements by changes in composition and heat treatment.

A knowledge of the factors effecting this versatility is valuable for selection of the right steel for the job. The purpose of this article is to provide such basic information; that is, an understanding of simple steel metallurgy, fundamental properties and available grades.

What Is Steel?

Steel is essentially the metallic element iron containing up to two percent carbon. Of course, other elements are present, but carbon is the most important one.

All metals are crystalline; that is, their atoms are arranged in definitely fixed patterns. The metal iron has a peculiar property in that it exists in two different crystalline forms or arrangements of atoms. At room temperature and up to 1670°F, the form is body centered cubic. That is, an atom at each corner of a cube and one at the center of the cube. This is called alpha iron or ferrite. At 1670° F, the atom arrangement changes to face centered cubic; an atom at each corner of the cube and one at the center of each face. This is called gamma iron or austenite.

The mere fact that there are two crystalline forms of iron would not mean much except for the very important fact that carbon is virtually insoluble in ferrite, or low temperature iron, while the austenite or high temperature iron, will dissolve up to 2.0 percent carbon.

The terms "insoluble" and "dissolve" are applicable here just as they are in ordinary solid in liquid solutions with which we are all familiar. A solid solution is identical except that both phases are solid.

Why Can Steel Be Heat Treated?

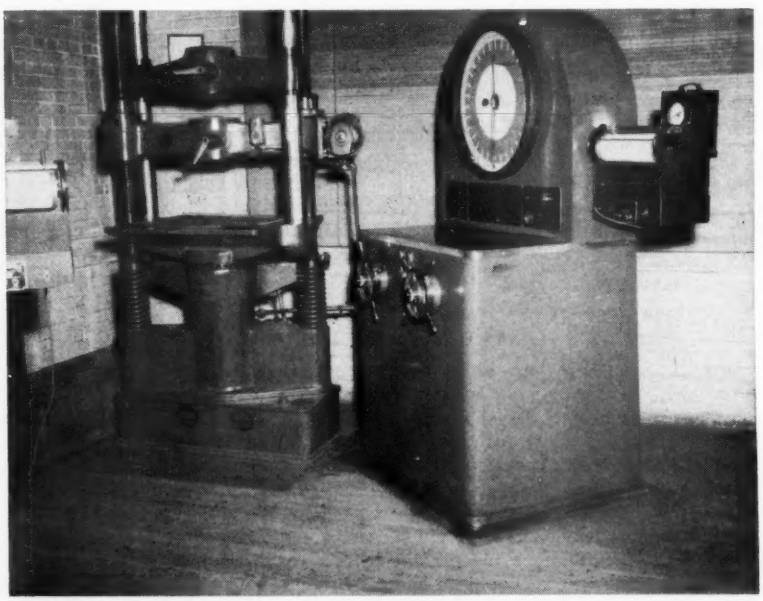
The basis of all steel heat treatment is the solubility of carbon in austenite, or high temperature iron and the insolubility in ferrite or low temperature iron. The point at which ferrite changes to austenite is called the critical point. As we have noted, this is about 1670° F in pure iron, but changes with the addition of carbon. At 0.80 percent carbon, it is 1333° F.

In heat treatment, we simply heat the steel to above the critical temperature, forming austenite and dissolving the carbon. When we cool to room temperature we have ferrite in which carbon is not soluble. The product is controlled by the speed of cooling from the high temperature. Simply stated, if we cool very slowly the carbon will come out of solution at the critical point and agglomerate in relatively large particles. This is annealing. If we cool at a very fast rate, the transformation to ferrite does not have time to take place near the normal critical point, and does not occur until just above room temperature. At this low temperature the carbon cannot precipitate and remains locked up in the crystalline lattice of the ferrite in a highly stressed structure. This is hardening. Now an intermediate cooling rate would allow carbon to precipitate in fine particles. This is normalizing.

Hardness-Guide to Service Properties

Hardness is defined as the resistance to indentation. It is determined by impressing into the specimen an indenter under known static load. Since no one combination of test load and indenter size has been satisfactory for testing specimens of all sizes and all degrees of hardness, it has been necessary to devise many hardness scales.

Two of the most common hardness



A typical tensile testing machine for determining the strength and ductility of standard machined samples

testers are the Brinell and Rockwell machines. Hardness determinations made by these machines on various steels are shown below:

Condition of Steel	Hardness	
	Brinell	Rockwell "C" Scale
Soft steel	180–240	8–21
Hardened for structural applications	240–400	21–43
Fully hardened	600	60

Hardness is a simple, easily made test and serves as a guide to such service properties as strength and wear resistance, subject of course, to other tests.

Tensile Properties.—Determinations of strength and ductility are made on standard machined samples pulled under steady load until failure. Two strengths are measured: 1) ultimate or tensile strength, which is the maximum load observed during tensile straining divided by the specimen cross-sectional area before straining, and 2) yield strength, which is the maximum load observed during tensile straining without marked deformation of the specimen.

The ultimate strength varies directly with hardness. A general rule of thumb in this respect is that one-half the Brinell hardness approximates the ultimate strength in thousands of pounds per square inch.

Two factors which measure ductility or the amount of deformation are determined after failure. They are: 1) elongation, which is the amount of permanent extension in the vicinity of failure, and 2) reduction of area, which is the amount of reduction in cross section at the point of failure. Elongation and reduction of area vary inversely with hardness.

Typical tensile properties for various types of steels are shown in Table 1. It can be noted here how ductility suffers with the increase in hardness and also the application of the general rule that one half the Brinell hardness approximates the ultimate strength in thousands of pounds per square inch.

Impact Strength.—Impact strength is a measure of toughness under dynamic loading. The resistance of a steel to fracture when notched and subjected to impact stresses varies approximately inversely with tensile strength to a strength level of 200,000 psi, provided the structure was fully hardened before tempering. At higher strength levels, impact resistance is low and changes little with increasing strength. For a given hardness or tensile strength, the greatest toughness goes with the lowest carbon content that can produce that hardness.

Tempering a quenched steel in the range of 550 to 750° F produces a characteristic anomaly in impact resistance, as shown in figure 1. This *temper brittleness* range is common to all hardened steels and has been attributed to the carbide distribution following martensite decomposition. It is, therefore, advisable to avoid this range in tempering to assure consistent tensile properties as well as higher impact strength.

To determine impact strength, specimens are fractured on a machine with a swinging pendulum. The energy absorbed in fracturing is measured in ft-lb.

The most common specimens in use are the Izod and Charpy types. The essential differences are the type of notch, notch location and sample position when fractured. Data obtained from one type of test specimen cannot be translated to another, though they usually tell the same story. Typical impact values for the steels for which tensile properties were shown previously are shown below.

Type of Steel	Impact Strength, ft-lb	
	Charpy Keyhole	Izod
Low carbon	30	42
High-strength low-alloy	40	55
Heat treated alloy	29	40
Ultra high strength	19	26

Fatigue Strength.—Fatigue is the tendency of a metal to break under conditions of repeated cyclic stressing considerably below the ultimate tensile strength. Fatigue strength, then, is the maximum stress which a metal can withstand for an indefinite number of cycles of stress without fracture. The terms fatigue strength and endurance limit are synonymous.

Mechanism of Fatigue Failure

The mechanism of fatigue failure can be explained briefly as follows. As mentioned previously, all metals are crystalline and, as such, contain planes of cleavage or slip oriented in many directions. Application of sufficient stress produces slipping on planes within the individual crystalline grains. Continued repeated slipping causes minute cracks to form. The end of such a crack is a minute area of highly localized stress, so there is a strong tendency for the crack to spread. The area of sound metal remaining in any cross section is gradually reduced until final fracture occurs.

Heretofore, the jagged appearance of the fracture led to the natural but erroneous conclusion that the metal had *crystallized*. Fatigue fractures start in the natural cleavage surfaces of the crystalline grains of a metal, or along crystal boundaries. Thus, the fracture has a crystalline appearance which is the result of the fracture rather than the cause.

Fatigue testing is conducted with specialized equipment and specimens, and it is, therefore, not a routine test, but more a tool of the development or research laboratory.

The test method consists of subjecting specimens to loads of various magnitudes and noting the number of cycles required for fracture. The results are plotted on a diagram—called the S-N diagram—and the stress where the curve becomes horizontal is the fatigue strength or endurance limit.

Generally, the fatigue strength of steel is considered to be proportional to tensile strength to a strength level of about 250,000 psi. Assuming no notch effect due to surface irregularities, the fatigue strength is usually in the range of 35 to 65 percent of the tensile strength, with an average value near 50 percent. The area of notch effect on fatigue properties is beyond the scope of this article and we wish only to touch upon it by saying that since fatigue failures originate at the surface where stresses are greatest, the best possible finish should be utilized.

Effect of Surface Stresses

The presence of compressive surface stresses produced through cold rolling, shot peening, case hardening, and so on have proven to be beneficial to fatigue life. Hence, the marked improvement in threaded bit ends through rolling the undercut and the considerable success of carburized drill rod in the mining field.

Factors Influencing Wear Resistance

The problem of wear is of vital concern since nearly everything that

Type of Steel	Tensile Properties				
	Ultimate Strength, psi	Yield Strength, psi	Elongation, %	Reduction of Area, %	Brinell Hardness
Low carbon	52,000	35,000	44	73	100
High-strength low-alloy	75,000	50,000	22	50	160
Heat treated alloy	175,000	160,000	16	48	341
Ultra high strength	270,000	230,000	11	40	500

Table 1. Typical tensile properties for several types of steel

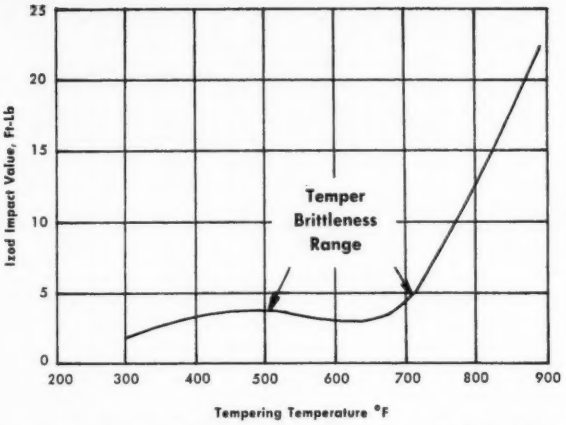


Fig. 1. Effect of tempering temperature on Izod impact value of fully hardened AISI 4150

moves causes and is exposed to wear. Wear resistance is resistance to gradual mechanical deterioration of contacting surfaces. It is not an inherent property, but is complicated by many factors, and cannot be determined without considering the specific conditions of service. The material itself, the mating material and the operating conditions all serve to cause different types of wear. Without a universal type of wear, there can be no universal method or machine for testing. Most laboratory tests available are, therefore, designed to simulate actual service.

The metallurgical factors influencing wear resistance are hardness, toughness, constitution and structure, and chemical composition. These factors can be controlled either in the melting stage or through subsequent heat treatment. However, the many variables connected with service contribute to the complexity of the problem of wear thereby making it not readily solvable. Thus, a steel proven definitely superior in one particular application may suffer a reversal in wear resistance by only a slight change in the conditions of service.

So far, we have been concerned primarily with the mechanical properties of steel. However, one other important property, corrosion resistance, should be mentioned briefly.

Inherent resistance of steel to corrosion is produced through the additions of alloying elements such as chromium, nickel and copper. Large additions of chromium and nickel produce steels which fall into the stainless category with superior resistance to chemical attack. Small additions of copper to low alloy steels can produce resistance to atmospheric corrosion of up to six times that of carbon steel. Of course, protective coatings such as paints, greases, and metallic and chemical coatings can be utilized for increased resistance to corrosion.

Carbon Content Determines Hardness

There is no one super steel available that combines the ultimate in all properties. However, by balancing the composition with additions of alloying elements and through variations in heat treatment, the ultimate can be approached in one, two or even three of these properties and a steel developed for maximum performance in a specific job.

Carbon, the most important element in steel, makes heat treatment possible and determines the ideal hardness that can be attained upon quenching. Figure 2 shows the effect of carbon on attainable hardness. This curve shows, for example, that a 0.30 percent carbon steel will not produce a hardness greater than about 50 Rockwell C. It also shows then, that at least 0.60 percent carbon is necessary to produce near maximum hardness in steel. Here we are considering surface hardness or hardness through thin sections.

Now, when higher hardness and strengths are required throughout heavier sections, alloying elements must be added to the steel to increase its hardenability, or the depth to which it will harden. More exactly, hardenability is that property of a steel which establishes the minimum cooling rate for satisfactory hardening. Hardenability does not mean the same as hardness. Hence, a steel of low carbon content can have high hardenability, or one of high carbon content can have low hardenability.

Two Categories of Alloying Elements

While there are many alloying elements used in the steel industry, in general, the most familiar ones can be divided into two categories. One group dissolves in the ferrite portion of the steel, while the other group combines with the carbide portions of the steel to form what are called complex carbides. The two general categories are, therefore, termed: 1) ferrite strengtheners and 2) carbide formers. Some of the common elements that fall into these categories are shown below.

Ferrite Strengtheners	Carbide Formers
1. Manganese	1. Chromium
2. Silicon	2. Molybdenum
3. Titanium	3. Tungsten
4. Copper	4. Vanadium
5. Nickel	5. Zirconium
6. Molybdenum	6. Columbium
7. Aluminum	7. Manganese
8. Chromium	8. Titanium

Some elements are common to both groups, namely, manganese, chro-

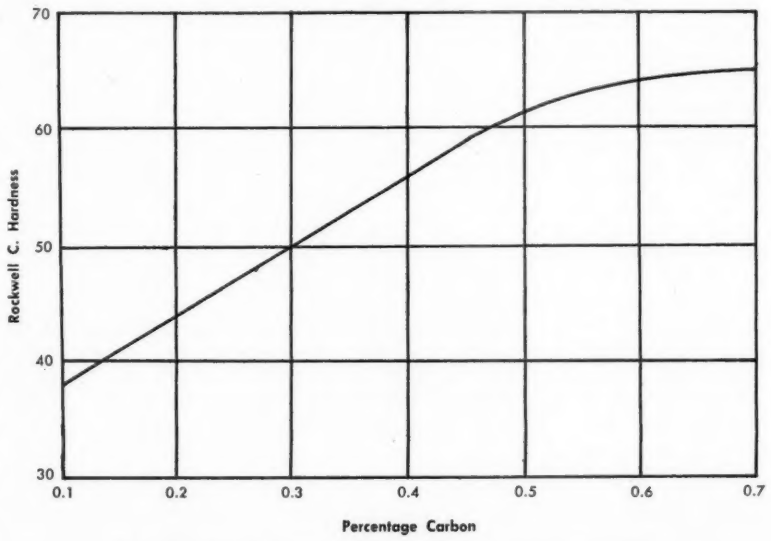
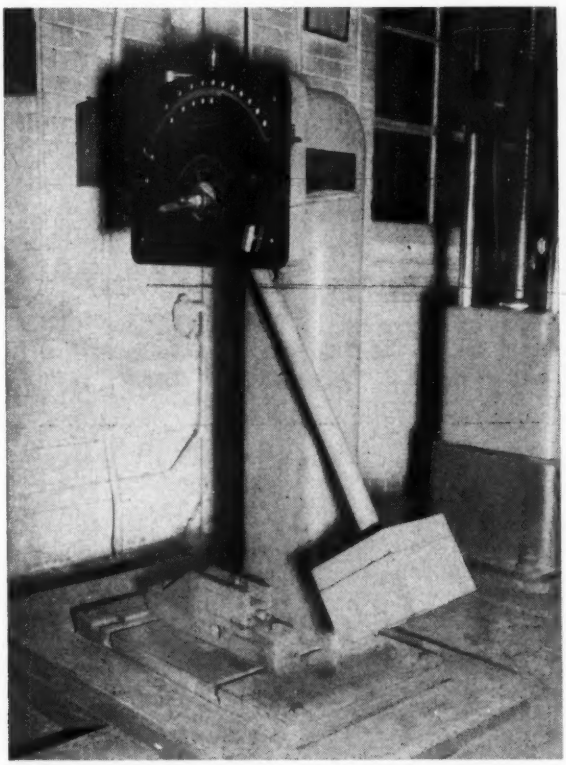


Fig. 2. Relationship between carbon content and attainable hardness

mium, molybdenum and titanium.

Practically any alloying element will increase the hardenability of plain carbon steel by lowering the normal critical point and making transformation more sluggish. It then follows that tensile strength and fatigue strength are increased in this same manner.

The elements which work best to increase hardenability are molybdenum, chromium, manganese, silicon, tungsten and nickel. Since some of these elements are ferrite strengtheners and some are carbide formers, it can be said that elements in each category will induce hardenability.



Impact strength testing machines measure the energy absorbed in fracturing a specimen, in ft-lb

Another reason for using alloying elements is that they increase toughness or impact strength of steel. Most ferrite strengtheners will increase toughness, the most effective being nickel, silicon and molybdenum.

Carbides and Manganese Steel

Certain elements are added to steel for their ability to increase wear resistance. Carbides are among the hardest materials known to man, so, as would be expected, the general category of alloys to enhance wear resistance would be the group of elements which create complex carbides. The most effective in this respect are chromium, tungsten, molybdenum and vanadium. Of course, accompanying high carbon content is essential.

One ferrite strengthener, manganese, is used to produce a highly wear resistant steel. Hadfield's manganese steel contains 13 percent manganese and remains austenitic at room temperature by the combination of high manganese content and rapid cooling from a high temperature. Heavy impact in service is essential to the superior performance of this steel.

High-strength low-alloy steels are intended primarily for weight reduction and longer life by means of greater strength and resistance to atmospheric corrosion than are obtainable from conventional carbon structural steels. Typical applications are: 1) truck and mine car bodies, 2) tanks and structural weldments, 3) screens, hoppers and chutes, and 4) buckets, scrapers and diggers. Some grades available include: 1) Corten, 2) Maxeloy, 3) N-A-X, 4) Mayari R, 5) Yoloy, and 6) Jalten.

General Purpose Alloys

Alloy steels offering a good balance of strength, toughness and hardness after heat treatment are available for general purpose use. These steels can be purchased in the heat treated condition from the mill and still be readily machined. Typical uses are for shafts, gears, studs, arbors, axles, jack screws, etc.

Grades include AISI steels such as 4140, 4150 and 6150 plus free-machining steels such as Maxel 3½, Ry-cut 50, and Hy-Ten B3X.

For critical applications requiring ultimate strengths up to 300,000 psi, the class of Ultra-High-Strength steels are available. These include AISI 4340, X-200, Hy-Tuf, HS 220, HS 260 and 300-M.

The Ultra-High-Strength steels just mentioned perform excellently when subjected to impact loading and shock. These grades are especially suitable for heavy duty axles and gears, speed reducers, torque shafts, power shafts, universal joints, drift pins and torsion wrenches.

Drill Rod Has High Fatigue Strength

With regard to fatigue strength, one of the most critical uses for steel in the mining industry is for hollow drill rod. The most successful grades are Crusca, Carbon Hollow, Ultra Alloy, CA Double Diamond, 4-E Alloy and, most recently, carburized 4320.

The Ultra-High-Strength steels also offer superior resistance to failure by fatigue. Typical uses are for bit bodies, couplings, and pneumatic tool parts.

Abrasion resisting steels such as A-R Steel and Jalloy #7 are used in material handling applications where heavy impact is not an accompanying service factor.

However, in applications where impact is present such as for rods and balls in crushing mills, loaders and loading chutes, and grouser bar for crawler equipment, the Hadfield's manganese steels give the most satisfactory service. Some modified analyses such as Ti-Mang, Manganal, Amsco, and Max-Wear offer the same service life plus ease of fabrication.

In place of the high-strength low-alloy steels with their increased resistance to atmospheric corrosion, stainless steels can be used in instances where the contacting media are of a particularly corrosive nature, such as in extractive processes of the mining industry.

In taking advantage of the versatility of steel, the proper selection of the right steel results in: 1) longer life, 2) greater payload, 3) lower operating cost, 4) greater safety, and 5) less maintenance.

By AUGUST MANIFEST
Superintendent
Marco Coal Co.

Preparing to open new cut at Marco Coal Co., crew loads 55-ft highwall with 30,000 lb of ammonium nitrate. Highwall contains 33,000 cu yd of overburden and is separated from spoil pile by 75-ft pit

MOVING OVERBURDEN With EXPLOSIVES

MOVING material is a strip mine operator's major concern. Regardless of whether he keeps detailed records for every operation, or simply knows by his bank balance that operations are profitable, the strip mine operator is always receptive to a new approach toward moving more material at less cost.

It was this concern with moving material that first made Marco Coal Co. consider the unusual overburden moving technique described in this article. A relatively small stripping operation, the company must get all it can out of the equipment. The investigation paid off for Marco now moves over 35 percent of the overburden without the use of equipment and uncovers about 30–40 percent more coal in the same time.

Previous Method Required Handling Part of Overburden Twice

Marco's stripping operation is located near Maysville, Pa., about 48 miles northeast of Pittsburgh. Overburden consists mainly of about 50 ft of sand rock and 15 ft of topsoil. Topsoil is 'dozed off before drilling.

Equipment includes a 2400 Lima dragline with a 110-ft boom, a D-9 Caterpillar with one-tooth ripper for binder removal, an 8M Davey rotary drill, and a Lorain shovel. Coal is hauled under contract.

Before the company began moving overburden with explosives, its operations were quite similar to other strip mines. It shot with ammonium nitrate, detonated with Primacord, and used only the amount of explosives to get breakage that the dragline could handle. After a shot, the dragline followed the customary practice of walking over the shot surface, digging a keyway, and casting across to the spoil pile. Several things about this method are obvious: first, practically all of the overburden is handled by equipment after each shot; and second, part of the overburden is actually handled twice.

Charge Initiated at Bottom with Millisecond Delay Caps

In 1959, after witnessing attempts at other strippings to move overburden directly to the spoil pile by the use of explosives, Marco adopted the new method at its operations.

The burdens, spacing, depths, and delay patterns for moving overburden by explosives were worked out by Atlas Powder Co. specifically for Marco's conditions. Outside holes are drilled to 7⅜ in. diam, while the rest are 6¼ in. diam. Burdens average 12 ft on 18 ft spacings. Depths of the holes average 52 ft, while the powder averages 1.2 lb per cu yd. The coal company now drills only a few more holes than before and uses almost the same amount of ammonium nitrate. Stemming has been increased from two to three ft; therefore, the powder factor remains practically the same. Primer cost has gone down because the company now uses a minimum

Blast moved over 45 percent of overburden directly to spoil pile and pit. Overburden remaining over coal seam is only 12 to 15 ft deep at most points

Shot material in pit needs no further handling by equipment. Coal seam is exposed at left near base of highwall

A new technique for moving overburden does the job faster, extends operating life of stripping equipment, lowers maintenance costs, and reduces 'dozer time in reclamation work

number of primers in a ratio of about 1 percent.

One of the most important differences, however, is that millisecond delay electric blasting caps are now used and each charge is initiated at the bottom. This gives maximum confinement and is responsible for the method's success.

When a charge is shot, rock sweeps across the pit and onto the spoil pile. Overburden shot into the pit is actually higher than that remaining on the coal seam.

What actually happens is that one-third or more of the overburden is shot across the pit and needs no further handling. The dragline now works from one end of the shot at a 45° angle to the highwall cutting a keyway. Then it walks along the spoil pile dragging from the keyway.

Besides moving one-third or more of the overburden directly to the spoil pile without the need for handling, this new method is also credited with extending the operating life of the equipment, cutting maintenance costs, and reducing 'dozer time in reclamation work.

30,000 Lb of Explosives Moved 33,000 Cu Yd of Overburden

Moving overburden by explosives has worked out well at Marco. One of its recent and most successful shots took place on February 25 when a new cut was opened up at one end of the pit. About 30,000 lb of Atlas' new ammonium nitrate pellets were used on this job to move approximately 33,000 cu yd of overburden. The highwall was about 55 ft high and the old pit was about 75 ft wide.

The charge was initiated at the bottom with millisecond delay caps and after the dust had settled, it was found that the shot was one of the best the company had ever had. Forty-five percent of the overburden rested against the spoil pile and in the old pit. Over the coal seam, the overburden had been removed at some places to within 12 to 15 ft of the seam.

Material remaining over coal seam is well broken and easy to handle by dragline. Average depth over coal seam is about 12 to 15 ft. Twenty-five ft of highwall has been moved directly to spoil pile and pit

Where Can This Method Be Used?

Moving overburden with explosives is an important new strip mining technique and will benefit many stripping operations with conditions like Marco Coal Co. Generally speaking, the higher the highwall, the lower the cost per yard for moving overburden by explosives. This is because of wider drill spacing. Other possible benefits of the explosives method are: (1) reduced cost for backfill due to the even spread-out of overburden, (2) easier handling of spoil on inside curves, and (3) a reduction in the amount of dragline hoist.

Moving overburden by explosives seems most directly useful in helping the operator with a high overburden do his job more economically regardless of the size and amount of his equipment.

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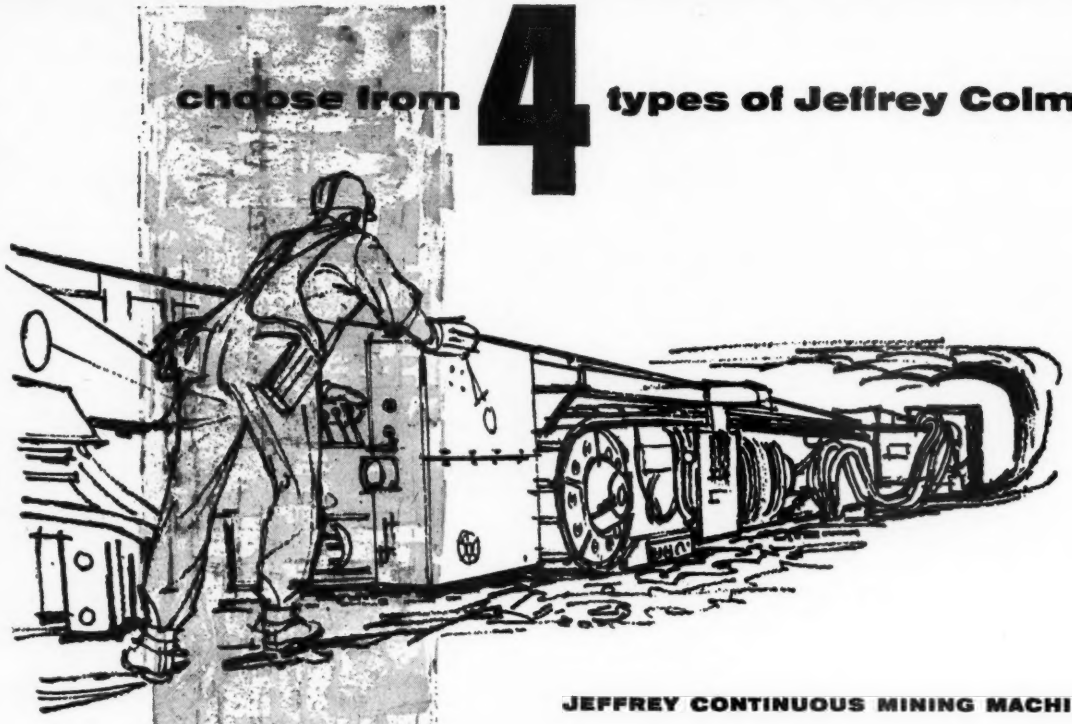

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Minimum mining height	28″	38″	50½″	67″
Width of cut	14′-7″	9′-8″	10′-9¾″	10′-9¾″
Minimum tramming height	25¼″	34½″	48¾″	63¾″
Width over crawlers	10′-0½″	72″	77″	77″
Length	34′-3″	29′-5½″	33′-10″	33′-10″
Tramming speed (feet per min.)	22′	20′	20′	20′
Feed speed (inches per min.)	0″ to 51″	0″ to 36″	0″ to 36″	0″ to 36″
Electric motors (total HP)	190	150	190	250
Weight—approx. (lbs.)	92,000	56,000	73,000	75,000

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By STEPHEN E. ERICKSON
Director of Beneficiation
M. A. Hanna Co.

New processes are being considered and various new procedures are under active development—the next several years should be most interesting ones as the potentials and economics of the various proposals are worked out in detail

TRENDS IN IRON ORE BENEFICIATION

IN the last few years two significant changes have occurred in the iron ore industry which have shaped the course of future beneficiation processes: (1) the decreasing importance of direct shipping or easily concentrated Mesabi range ores, and (2) recent blast furnace demands for higher quality raw materials.

In the attempt to produce high quality iron ore products for blast furnace consumption, a number of new processes are being considered and various new procedures are under active development. It will be the purpose of this article to briefly review all of these newer trends in the art of iron ore beneficiation.

Washing

The original iron ore concentrators on the Mesabi range consisted simply of washing plants. These pioneer plants contained log washers and trommel screens for scrubbing the ore. The latter were subsequently replaced by vibrating screens and log washers were eliminated. The log washer is a high cost and high maintenance machine, which is troublesome to operate particularly in the event of power failure.

Quite recently rotary scrubbers have been added to a number of iron ore beneficiation plants and these devices are receiving intensive study and development. A rotary scrubber is essentially a ball mill in which no grinding media is used, but the ore itself acts as a scuffing and abrading medium.

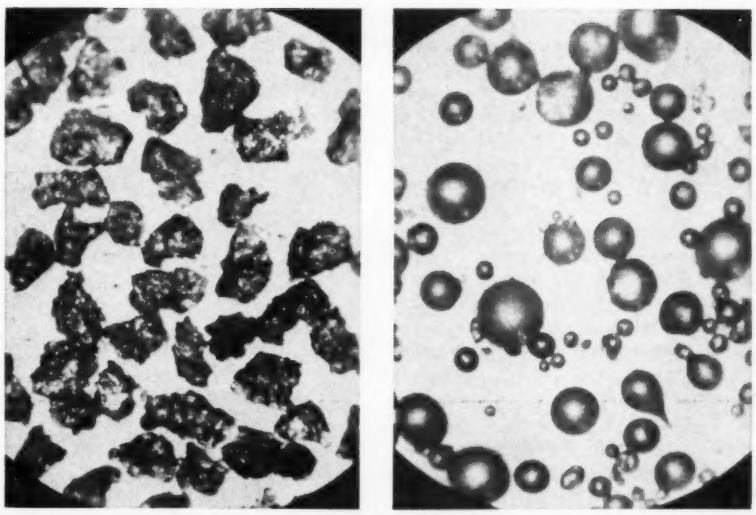
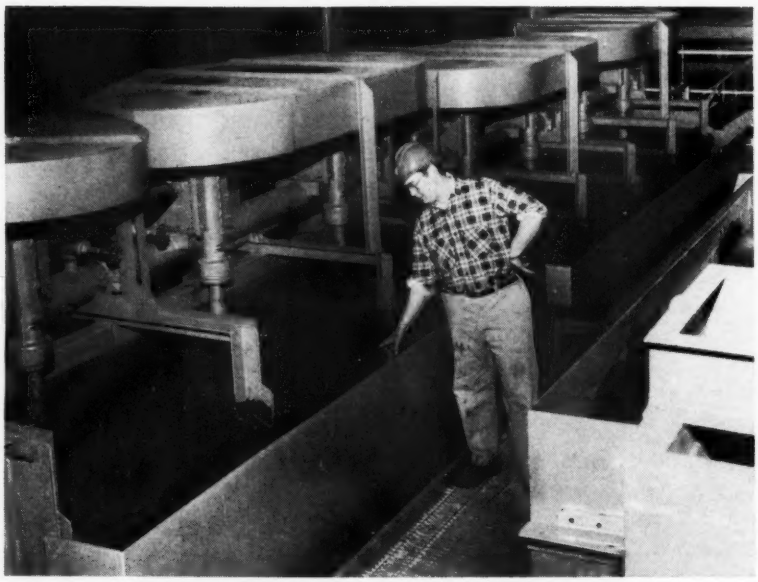


Fig. 1. Photomicrographs of ground ferrosilicon (left) and spherical ferrosilicon (right) used in dense media processes

Scrubbing gives improvement in grade by removing loosely bonded siliceous material from the ore pieces. It helps to produce higher grade concentrates in heavy medium processes and assists in reducing media viscosity problems. On "painty" or clayey ores, scrubbing helps remove clay so that the concentrates will drain more readily and thus give higher natural iron analyses.

Several rotary scrubbers have been installed on the Mesabi range with encouraging results and it appears that there will be a number of additional installations in the near future. Considerable test work is in progress on the mechanics of the scrubbing.



Flotation of specular hematite at Groveland mine of M. A. Hanna Co.—one of three commercial plants in Michigan that use flotation. The process has worked best in those special situations where the iron oxide is present as hard, clean hematite

Heavy Media Vessels

Recent development work on dense media vessels has been along the line of trying to adapt the cyclone to handle coarse ore particles up to two in. or so in size.

Two machines which have been tested on a pilot plant scale are the Dorrclone and the Dyna-Whirlpool. These are somewhat similar devices in which only the media is pumped into the vessel; the ore is fed into it without going through the pump. In the Dorrclone this is accomplished by the use of a constant head tank where the ore and media are mixed. In the Dyna-Whirlpool the ore and media are fed separately into the vessel without pre-mixing. Both of these devices show promise, particularly for small plants where low capital cost is a consideration.

Heavy Medium

Heretofore the medium used in dense media processes has been ground ferrosilicon (fig. 1). Recently, atomized material has been imported from Germany for large scale testing. Reports on the testing of this material appear at first glance to be somewhat conflicting, but investigation shows that two types of atomized material are marketed by the Germans, a normal quality and a special quality.

Microscopic examination of the normal quality material indicates that it consists essentially of irregularly shaped particles with only a small percentage of solid spheres. The normal quality media acts about the same as if it were ordinary ground material.

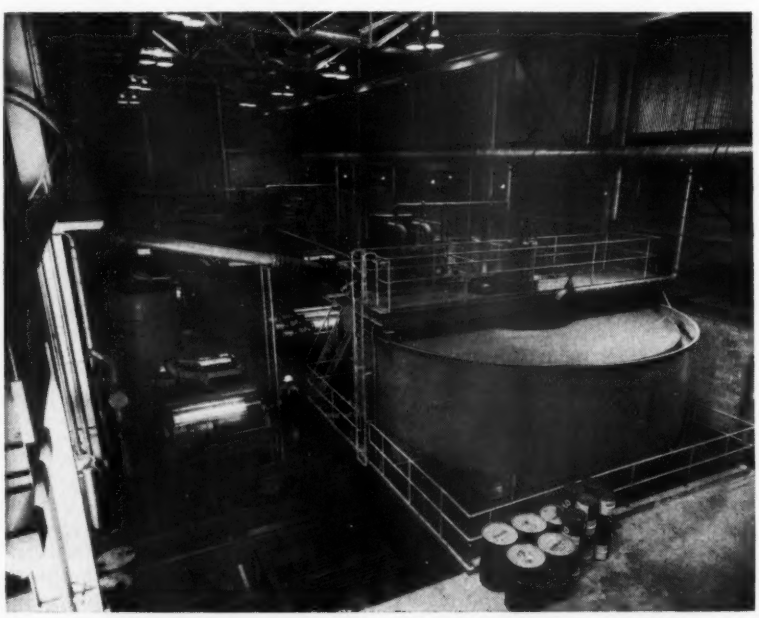
On the other hand, microscopic examination of the special quality media indicates that it is essentially composed of solid spheres. This material, when compared to ground material, gives a higher operating gravity, lower media loss, lower pumping power consumption and fewer viscosity problems, but it costs $36 more per ton. One point that has not been established as yet is whether the spherical media will work equally as well in all types of dense media vessels.

Flotation

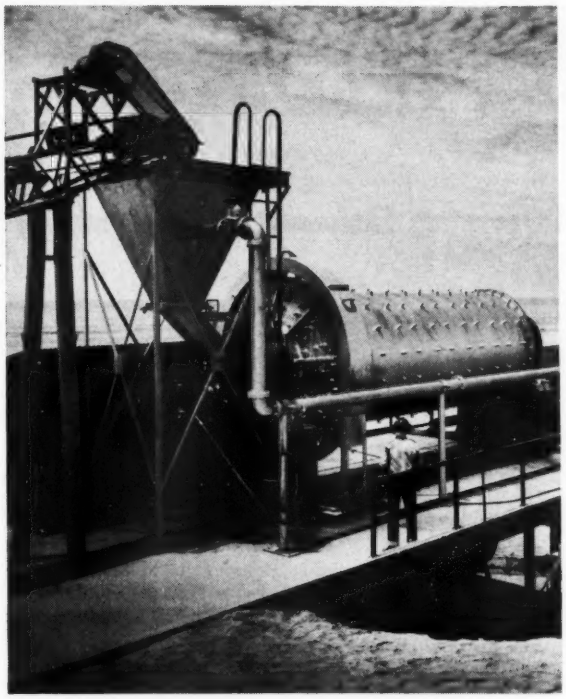
There are now three commercial plants in Michigan that use flotation. At the Humbolt and Republic mills flotation is the principal process, and at Groveland a combination of spirals and flotation is used. The Michigan ores consist of specular hematite with relatively little clayey slime material.

In Minnesota, a pilot plant utilizing spirals and flotation has operated for two years on old washing plant tailings at the Hill Annex mine. A commercial plant for this property is now in the design stage.

In general the flotation processes have not worked out too well on iron ores except in the special situations where the iron oxide is present as specularite or as hard, clean hematite. The presence of painty or clay-like material or the presence of ocherous limonite cause poor flotation results. Conditioning at a high pulp density for a relatively long time interval greatly improves flotation results, but the process is still not universally applicable. However, further research work may solve the flotation problems that are still troublesome.



Magnetic separator and Hydroseparator section in Moose Mountain mine beneficiation plant of Lowphos Ore Co. The plant is rated to produce 1700 tpd of concentrates from 3500 tpd of run-of-mine magnetite



Scrubbing gives improvement in grade by removing loosely bonded siliceous material from the ore pieces—the ore itself acts as a scrubbing and abrading medium. Pictured here is a 7 by 16-ft Marcy scrubber

Magnetic Taconite

The commercial taconite plants in Minnesota, Reserve and Erie, which have been well publicized, are designed to handle only taconite in which the iron is present in the form of natural magnetite. The flow schemes of these plants consist of fine grinding, cyclone classification and wet magnetic separation. Similar flow schemes are in use in a number of new and smaller concentrators; among these are Hilton, Marmora and Moose Mountain.

Plans have been announced for several more magnetite concentrators which will be built to utilize the same general flow scheme.

Hematite Ores

On the Mesabi Range, taconite which contains a preponderance of hematite is designated as non-magnetic taconite. Where hematite is massive and relatively coarse, the use of spirals or tables has been successful. In Michigan, where the hematite is present in specular form, the flotation process has been satisfactorily used.

For other types of hematite bearing materials, such as the Mesabi range non-magnetic taconites, a different procedure has been proposed and has been tested on a pilot plant scale. It consists of roasting the ore under reducing condition so that hematite is converted to magnetite which is then recovered by fine grinding and magnetic separation. After the reduction-roasting step, the procedure is analogous to that presently used for magnetic taconite.

A number of types of apparatus for reduction roasting have been investigated. Shaft type furnaces, FluoSolids reactors, and rotary kilns have been tested and, at present, the rotary kiln appears to be in greatest favor. The Lurgi kiln, which was designed and used in Germany, appears to be the most promising, and several organizations are presently considering pilot plant installations. Fuel for the kiln would be either natural gas or producer gas made from coal.

Semi-Taconite

In 1959 the Minnesota legislature established semi-taconite, also called soft taconite, as a new classification of material. Broadly speaking, semi-taconite is anything between hard, solid taconite and the material that can be economically treated in the present washing and dense media plants.

Much test work on semi-taconite has been conducted and construction of several pilot plants has been proposed. No definite flow scheme has been evolved at this time, but present thinking is that it will be a combination of washing and dense media treatment followed by reduction roasting and magnetic concentration of the middling fractions. The use of reduction roasting alone appears to be too expensive; therefore, an attempt will be made to combine it with cheaper processes so that an overall economic result can be obtained.

Dry Concentration Processes

The growing interest in dry methods of concentration, concurrent with development of these methods, is perhaps one of the most important trends in iron ore beneficiation. The development of dry methods of grinding with the Aerofall mill and the Hardinge Cascade mill have increased the interest in dry methods of concentration. This trend has been further accelerated by the recent interest in the low grade ores of the Wabush area of Labrador. Where cold weather is a problem for much of the year there is obvious incentive to develop dry methods.

For magnetite ores, low-intensity dry magnetic separators that combine magnetic and centrifugal forces have recently been developed. This type of machine is represented by the Swedish Mortsell machine in which the magnets are stationary and the drum rotates around them. In the Finnish Laurila machine both drum and magnets rotate and the concentrate is removed by means of a take-off roll; whereas, in the Canadian developed Research-Cottrell machine the drum and magnets both rotate but they are eccentric to each other. This eccentric action combined with centrifugal force removes the material from the drum surface. It has been proposed to use these types of separators for both natural magnetites and for the discharge of a reduction-roasting kiln.

Another interesting development is in the field of high-intensity magnetic separators. Developed in Germany by two different organizations, these machines consist of a six in. diam corrugated roll which rotates between two pole pieces. A magnetic strength of about 23,000 gauss is induced on the roll, and then the ore is fed between the roll and pole pieces. With this high intensity machine, hematite or even limonite can be separated magnetically without the necessity of reduction roasting. The process holds promise particularly for the dense, clean separating hematite ores in which there is no serious middling problem.

Still another dry separation process, which is now under intensive development is the high-tension or electrostatic process. The process was

(*Continued on page 72*)

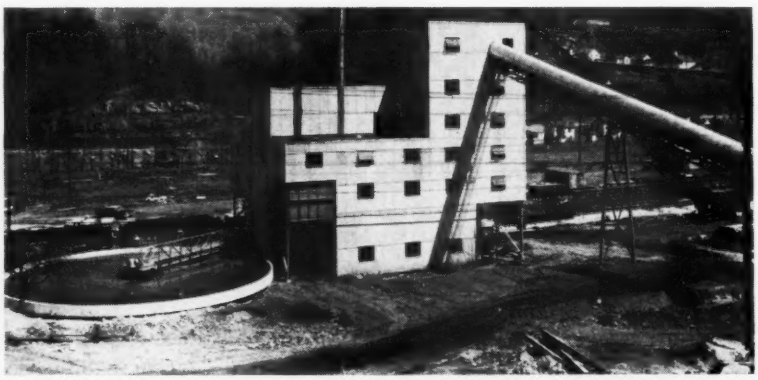
SIMPLICITY IS KEYNOTE OF

Minimum of Operating Equipment is Employed at

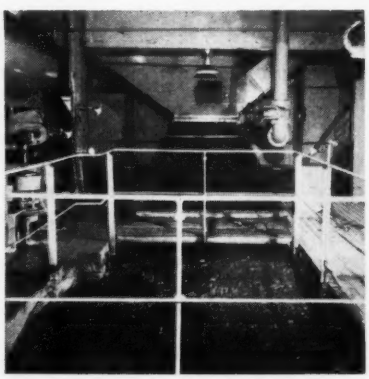
A COAL preparation plant that is outstanding for its simplicity of design, using a minimum of operating equipment to accomplish its purpose, was recently completed for the Wisconsin Steel Division of International Harvester Co. The facility is located at Benham, Ky., in the heart of the Cumberland Mountains.

Coal from Wisconsin Steel's mines is shipped to Chicago to produce metallurgical coke for firing the company's blast furnaces. For many years the coal has been mined from the "B" and "C" seams, and fortunately these coals were clean enough so that preparation was not required. However, the "C" seam has recently become exhausted. Although large quantities of coal from the "B" and "D" seam are still available for future mining, the characteristics of the "D" seam dictated a coal preparation plant.

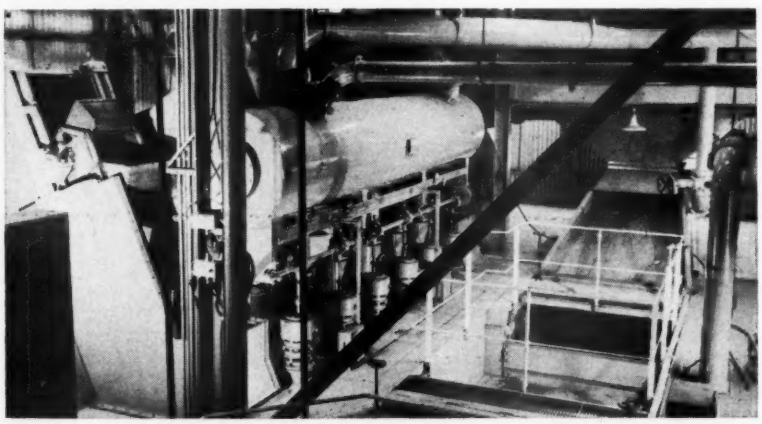
The new coal preparation plant, which was designed, built and erected by Link-Belt Co. on a "turnkey" basis, has a capacity of 400 tph of run-of-mine coal, delivered as a mixture of "B" and "D" seam coal. It employs a two-cell, six-compartment Baum jig for primary separation of coal and refuse, and concentrating tables for further cleaning of fine coal. The water clarification system includes a thickener.



Wisconsin Steel's new coal preparation plant is outstanding for its simplicity of design, using a minimum of operating equipment to do its job. Coal from two seams is received in mine cars and stored separately in two bins. It is blended as desired by variable capacity reciprocating feeders and delivered to the belt conveyor at right, which carries it to the top of the plant at a rate of 400 tph



Minus five-in. coal is delivered at 400 tph to a Baum jig. Water is forced through submerged screens by pulsating air pressure which causes a stratification of coal and refuse



In a wash box the coal moves progressively from cell to cell and is flumed off as clean coal, while refuse settles to bottom and is drawn off submerged screens to an elevator. Sink middling product can also be drawn off submerged screens to elevator, crushed and fed to fine coal circuit

NEW COAL PREPARATION PLANT*

Wisconsin Steel Division's Plant at Benham, Ky.

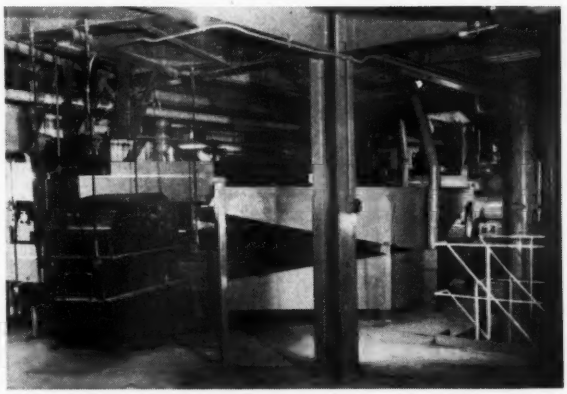
Coal is brought from the mine in drop-bottom mine cars and discharged into two 500-ton bins. "B" seam coal goes into one bin and "D" seam coal into the other.

Under each bin is a 42-in. reciprocating feeder which has a variable capacity ranging from 150 to 250 tph for blending coal from the two seams in desired proportions. The two feeders discharge to a 42-in. wide belt conveyor which carries 400 tph of coal to the top of the coal preparation plant. The coal discharges onto a stationary steel bar grizzly which removes the minus five-in. material.

Plus five-in. material discharges into a rotary breaker, 9 ft in diameter and 16 ft long, for crushing to minus five-in.

* Courtesy of *Line-Belt News*.

All processing and conveying equipment is controlled from a control panel adjacent to the wash box. The motor control center is seen at left



Fine coal is cleaned on four double-deck tables. The clean coal discharges from the side of the table while refuse passes off the end. The clean coal is then flumed to a collecting sump and pumped to a 24-in. diam. cyclone, which thickens and classifies the underflow

Washing and Separation

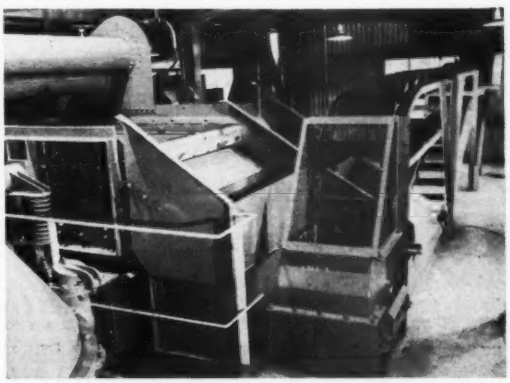
The through product from the grizzly and the minus five-in. breaker product are combined in a common hopper and are fed into the inlet sluice of the jig.

A middling product is drawn off and either discharged to refuse or crushed to minus ¼-in. and fed to the fine coal circuit.

Clean coal is dewatered and sized on a double-deck vibrating screen where the minus ¼-in. product and the water are removed. The plus ¼-in. product normally discharges directly to the loading-out belt. However, the screen is arranged to produce two sizes of house coal, 5 by 1¼-in. and 1¼ by ¼ in., for sale to local users. A flight conveyor can carry the 5 by 1¼ in. product to a storage bin, and a flop gate can be arranged to discharge the 1¼ by ¼-in. product directly to its bin.

Fine Coal System

The ¼-in. by 0 product, together with the water, is discharged from the dewatering screen directly to two cyclone feed sumps. From the sumps it is pumped to four 24-in. low pressure cyclone classifiers which pro-



Clean float coal is dewatered on double-deck vibrating screen. Water and minus ¼-in. coal go to fine coal system. Plus ¼-in. product usually discharges directly to loading-out belt, but screen can produce two sizes of coal for sale to local users. A flight conveyor can carry 5 by 1¼-in. product to storage bin, and a flop gate can be arranged to discharge the 1¼ by ¼-in. product directly to its bin

duce a thickened overflow containing about 40 percent solids. This material is then fed to four double-deck concentrating tables.

Clean coal from the tables is flumed to a collecting sump, and from here it is pumped to a 24-in cyclone. Underflow from this cyclone is fed to a 6 by 16-ft 48-mesh single-deck dewatering screen. The plus 48-mesh material is discharged to one of two centrifugal dryers —one is a standby unit.

Car Loading

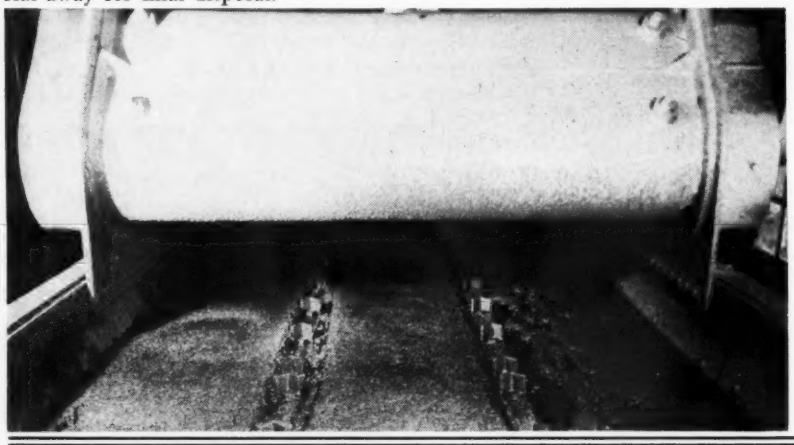
The centrifugally dried product joins the dewatered 5 by ¼-in. product on a 36-in. loading-out belt conveyor. The belt conveys the coal a short distance to a single-track railroad loading station.

The effluent of the clean coal cyclone is returned to the clean coal sump which always has an overflow to the 70-ft diam thickener. The underflow of the clean coal cyclone goes to the clean coal dewatering screen. The underflow of the clean coal screen can either go to the raw coal sump or join a cut taken from the raw coal cyclones and the overflow of the clean coal sump feeding the thickener. The clarified water overflow is returned to the plant for reuse.

The fine solids are pumped to a ten-disc vacuum filter, 8 ft 6 in. in diameter. The filter cake discharges to the refuse conveyor, which also conveys the minus five-in. refuse from the wash box and the minus ¼-in. dewatered refuse from the concentrating tables. This material is carried to a refuse bin, joining the rock refuse from the breaker.

A motor-operated gate beneath the refuse bin permits easy loading into a refuse truck which carries the material away for final disposal.

Fine suspended solids are flumed to 70-ft diam circular thickener. The solids settle and are raked off the conical bottom, while the clarified water overflows and returns to the plant for reuse



Closeup of screen section of vibrating screen, which dewaters minus ¼-in. coal ahead of centrifugal drying. The screen cloth has ¼-mm openings

TRENDS IN IRON ORE BENEFICIATION

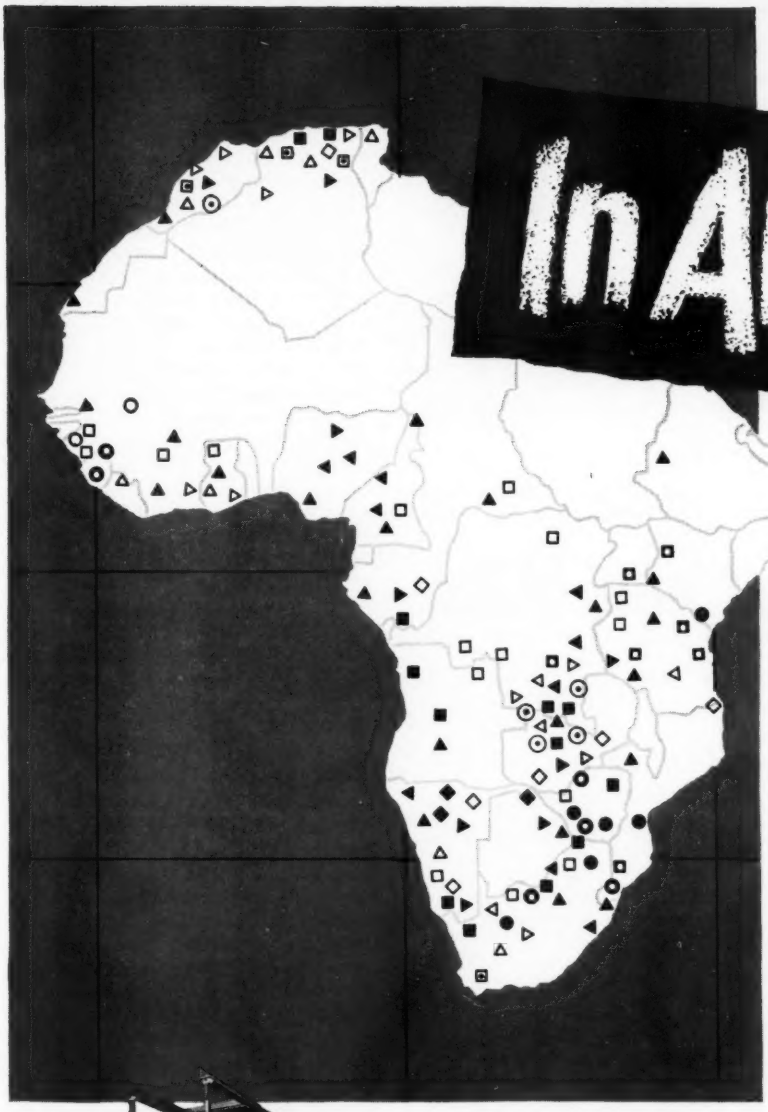
(*Continued from page 69*)

investigated several years ago and was abandoned, but it has recently been revived with work on the Carpco separator and the newly developed Dings machine. It will effectively separate hematite without previous reduction roasting, but the ore must be bone dry and preferably warm when fed into the process. The high tension processes have worked well in the laboratory, and continuous pilot plant tests are planned by several organizations.

Direct Reduction

Development work on direct reduction processes continues to hold the interest of the industry. Several new processes have been announced but none of them, so far, appear to be economic except for special situations. There are no commercial continuous direct reduction plants in operation as yet, but in view of the large amount of work that is being done on these processes it would appear to be principally a matter of time before they are used for commercial beneficiation of iron ores.

There are a considerable number of different iron ore beneficiation processes which are under test and development at the present time. The next several years should be most interesting ones as the potentials and economics of the various proposals are worked out in detail.



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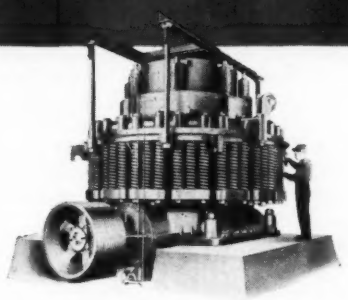

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RADIATION HAZARDS in Uranium Mines and Mills*

Major safety problems confronting the uranium industry will be solved, and the high standards established for protection of employes and the public will be met

By JESSE C. JOHNSON
Director
Division of Raw Materials
U. S. Atomic Energy Commission

THE uranium industry, like other industries in the atomic energy field, must comply with the radiation standards set forth in the licensing regulations issued by the Atomic Energy Commission and in the laws and regulations of various uranium-producing states. AEC regulations in the field of raw materials are limited to uranium milling operations and to the usage and possession of radioactive products after removal from their place in nature. AEC does not exercise regulatory authority over uranium mines. However, several of the uranium-producing states have incorporated controls for radiation exposure in their mine safety regulations.

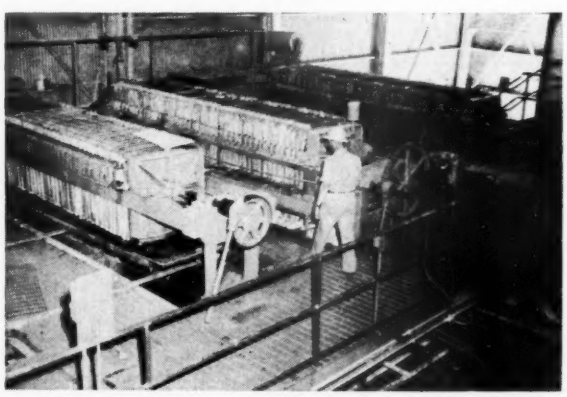
The potential danger of exposure to radiation has become a matter of major public concern. The extended discussions on atomic fallout have contributed to the concern about the possibility of danger from continued exposure to even small amounts of radiation. In August, 1959, the President established a Federal Radiation Council composed of the Secretary of Health, Education, and Welfare, the Chairman of the Atomic Energy Commission, the Secretary of Defense and the Secretary of Commerce. This council will advise the President with respect to radiation matters directly or indirectly affecting health. It also will take steps toward a coordinated governmental approach to the over-all program associated with radiation.

The use of atomic energy for military and civilian purposes, with the attendant tremendous expansion in the production and processing of uranium ores, has introduced new sources of radioactive materials into man's environment. It also has created new types of problems which require thorough study and careful long-range planning. This discussion will be concerned with current problems relating to uranium production.

Early Field Investigations

Ten years ago Free World uranium production was only about 2000 tons of U_3O_8 per year, while today it is nearly 40,000 tons. Total domestic production in the year 1949 was about 90,000 tons of uranium ore and 115 tons of U_3O_8 in mill concentrates. Domestic mines now have an output of nearly 7,000,000 tons of ore a year and mill concentrate production is about 18,000 tons of U_3O_8.

Although ten years ago our uranium industry was relatively small and its radiation problems did not appear serious, field investigations were initiated at that time to determine the nature and extent of these problems, if any. Many of the field studies were made by the U. S. Public Health Service, with technical cooperation and financial support by the AEC.



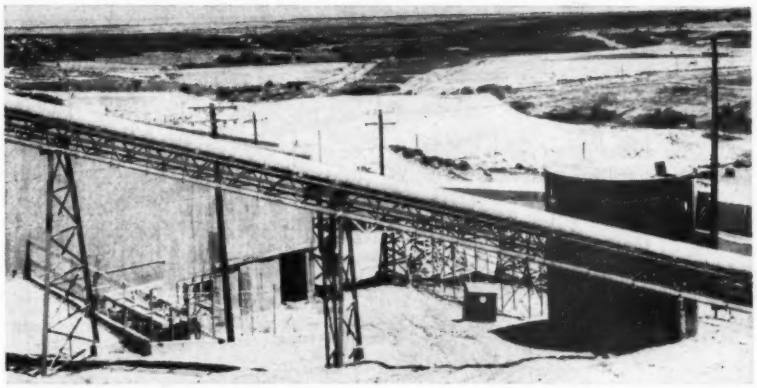
External radiation appears to present only minor problems. Both crude ore and uranium concentrate emit only low level radiation, which is not considered dangerous under normal working conditions

** Based on press release version of talk given September 16, 1959, at the AMC 1959 Mining Convention.*

Other surveys were carried out by AEC groups. State organizations participated, particularly in the planning and in the study and discussion of the data collected. As information was studied and tentative conclusions reached, reports and technical papers were published. The field studies indicated that in a number of the uranium mines concentrations of radon products were excessive.

In June, 1954, a maximum allowable radiation concentration was incorporated in the mining laws of the State of Colorado. In February, 1955, the State of Utah sponsored a "Seven State Uranium Mining Conference on Health Hazards." Approximately 100 representatives of state and federal organizations and members of the uranium industry attended the two-day sessions. Discussions were devoted almost entirely to the potential radiation hazards in uranium mines. As a result of this conference and other studies, the Industrial Commission of Utah in January, 1956, by regulation prescribed a maximum limit for radon products in mine air.

Definite conclusions on the biological effects of the mine and mill radiation exposure are difficult to arrive at because the potential hazards relate to possible long-term effects. On this subject there is a lack of basic data, much of which can be obtained only by observations extending over a long period.



The major problem of the mills is disposal of waste products—effluent liquors and tailings. Effluent liquors must not be allowed to contaminate surface and underground water resources. Preliminary work by the Winchester Laboratory indicates that neutralization followed by barite treatment may effectively reduce the radioactive content of waste liquors

Radiation Exposure Limits

The establishment of acceptable standards by scientific agreement was therefore essential to any control and regulation of radiation hazards. In 1949 there were no generally accepted standards of permissible limits for internal exposure to radiation. An international meeting held at Chalk River, Canada, in September, 1949, suggested certain limits. These suggestions were tentatively accepted by the International Commission on Radiological Protection at the Sixth International Congress of Radiology which met in London during July, 1950. However, acceptance was qualified by stating that at the time there was insufficient information to make firm recommendations concerning maximum permissible exposures to internal radiation from radioactive isotopes. Handbook 52, titled "Maximum Permissible Amounts of Radioisotopes in the Human Body and Maximum Permissible Concentrations in Air and Water," which was published by the National Bureau of Standards in 1953, essentially followed the Chalk River Conference suggestions. This handbook became the basis for interpreting data obtained from the field surveys of our western uranium operations.

In 1957 the Atomic Energy Commission established for regulatory purposes standards governing radiation exposures in AEC-licensed operations. These standards were published in the Federal Register and are found in Title 10, Code of Federal Regulations, Part 20. For the protection of the general public, the Part 20 radium and uranium limits for continuous exposure in unrestricted areas are one-tenth of those recommended in Handbook 52. However, for occupational exposure, which is limited to 40 hrs per week, the limits for concentrations of radium and uranium are three times higher than the continuous exposure values in Handbook 52.

The earliest indication of a special health hazard in uranium mining was the experience in certain European mines. It was known in the 16th century that many of the workers in the Bohemian and Saxon mines of the Erz Mountains had an unusually high incidence of lung disease. It was not until 1879, however, that certain European investigations through clinical and anatomical research ascribed the affliction to a malignant tumor of the lungs. Although originally worked as silver mines, and later exploited for cobalt, nickel, bismuth and arsenic, these mines contained pitchblende which, about 1900, was used as the source of radium. The early mining operations were primitive and, in addition to a high radon content, the air undoubtedly contained excessive amounts of dust laden with cobalt, nickel, arsenic and other minerals. Although it is now generally accepted that radon products were an important factor in the lung damage, there is a question as to the contributing effects of the other contaminants of the mine air.

Colorado Initiates Study of Hazards

The reports of these European investigations led Dr. Roy L. Cleere, of the Colorado Department of Health, to propose an advisory council to consider the possible danger of radon exposure in Colorado uranium mines. This council was formed in 1949 and included representatives of the AEC, the U. S. Public Health Service and the health organizations of states concerned with uranium mining.

Environmental studies started in 1949 were expanded in 1950 to include uranium mills, as well as mines, and the sampling of streams which received effluent liquors from the mills. Medical examinations of mine and mill workers were also begun. Field studies were carried on by Public Health Service and by AEC directly, but nearly all were financed by AEC.

The initial laboratory and clinical studies begun in 1950 covered a group of more than 1100 mine and mill workers. Since then, the study group has returned every three years to the mines and mills for additional laboratory and clinical data and every two years to obtain census information on the workers.

As part of this program, the AEC, through its Division of Biology and Medicine, in 1951 began making periodic uranium analyses of urine sam-

ples from all employes at its Monticello mill and Grand Junction facilities. Public Health Service made similar examinations of employes at privately-owned mills though on a less extensive scale.

During the period November 1956, to September 1957, the AEC's Health and Safety Laboratory conducted radiological surveys at 12 mills. The results of these surveys were sent to all of the operating mills.

These surveys showed that most of the mills had inadequate dust collecting systems in the dry sections and were in need of better hygiene procedures.

Regulations Led to Mill Inspections

Under regulations and standards established by the Commission in 1957, AEC began a series of mill inspections late in that year. These initial inspections indicated that most mills had failed to make required surveys and to keep records which would show the extent of radioactivity in mill working areas and in mill effluent. The mills were notified of this situation by letter and in response the companies stated that they would take remedial action. Follow-up inspections begun in 1958 and still continuing indicated that, in general, reported plans had been carried out only partially. The Commission therefore issued on May 22, 1959, the first of a series of letter orders directing that steps be taken without further delay to correct the situation. The continuing inspections include analyses of air and liquid samples where required.

As mentioned earlier, the program established in 1950 with AEC financial support included studies of the streams which might be contaminated by radioactive wastes discharged by uranium mills. In 1950 eight water samples from three rivers were taken by Public Health Service and state agencies and analyzed for radium by the University of Rochester. During 1951 and 1952, 12 additional samples were collected and sent to the Public Health Service laboratory at Cincinnati for analyses.

Stream Contamination

In 1955 a further study of stream contamination was carried out by Public Health Service at the request of several state organizations. The AEC did not finance this work but was kept informed of the results. Six streams involving eight uranium mills were sampled. Only one sample, that taken of the San Miguel River below the Uravan mill, exceeded the maximum permissible tolerance set forth in the Bureau of Standards Handbook 52. The San Miguel, which is not used as a source of domestic water, was also the only stream shown to be above the permissible limit by the earlier surveys. However, the 1955 data did indicate a general increase in the amount of radioactivity as compared with the earlier sampling. This led to a decision in April, 1958, to make a detailed survey of the Animas River, one of the streams included in the previous samplings. This survey, initiated by request of the New Mexico Department of Public Health, was carried out and financed by the Public Health Service. Since 1956 the Public Health Service, by statute, has had the responsibility for determining whether interstate streams were being contaminated by industrial operations.

The Animus River survey required nearly a year and the report was issued at Santa Fe, N. M., in June of 1959. This survey showed that at several points where the water is used downstream from the Durango mill, the radium concentration was 2½ times the maximum permissible concentration recommended by the National Committee on Radiation Protection. There are some natural water supplies both in this country and in Europe which have a similar high radium content. These have been used for years as a source of domestic water. With reference to the Animas River, the AEC and Public Health Service experts have stated that no immediate health hazard exists. However, a long-range problem is developing and corrective measures must be taken promptly to bring the mill effluent within the permissible limits prescribed in AEC's licensing regulations. The company, which was put on notice last May by an AEC order, has been making changes in an effort to bring the mill into compliance.

[Note: A subsequent report, covering a later survey made after corrective measures were taken by the Durango mill, indicates that the radium concentrations of the river at important points of usage downstream were reduced by factors of 50 to 85 percent from those of the earlier survey.]

Winchester Laboratory Aids Industry

The role of the Divisions of Raw Materials in these investigations originally was limited to assisting the survey teams by furnishing transportation and personnel, collecting mine samples and studying ventilation effects, and collecting dust and urine samples at the AEC Monticello and Grand Junction operations. However, in 1957, following the issuance of AEC's licensing regulations, it appeared that detailed mill surveys and studies would be required to determine what changes might have to be made in mill operation to comply with these new regulations and standards. Although this is the responsibility of the mills, the Raw Materials Development Laboratory at Winchester, Mass., had an experience and capability which could be used to assist industry by pointing out some of the problem areas and by studying possible solutions. The Winchester Laboratory, which also had operated the Grand Junction pilot plant, had a major part in developing the metallurgical processes used in most mod-

Studies indicate that in most cases good ventilation, using conventional equipment, will reduce the concentration of radon and its daughter products to acceptable levels. This means good ventilation in all areas

ern uranium mills. An important adjunct to this process work had been the development of suitable and practical analytical methods.

On the basis of these considerations, the Winchester Laboratory in 1957 was authorized to undertake a study of uranium mill operations to develop procedures for reducing radiological hazards. The initial work was promising and the work is continuing in association with the Division of Biology and Medicine.

The work done by the Winchester Laboratory to date has resulted in several important contributions. Rapid analytical procedures for radium and thorium were developed which are suitable for use in the mill laboratories. This development reduced the time required for low concentration radium analyses from about one month to one day. There is still need for further research to develop accurate analytical methods for the low level concentrations of radium and thorium which occur in mill liquors.

Winchester also studied the chemical behavior of these radioactive isotopes in the mill processes. These studies disclosed that radium and thorium are slightly soluble in the leaching liquors, but the extent of the solubility is quite variable for different processes and different ores. Mills using the carbonate process generally dissolve only about one percent of the radium content of the ore, while acid process mills may dissolve up to five percent.

Reducing Radioactive Hazards

Work was also done on the purification of effluent liquors. It was found that neutralization followed by barite treatment greatly reduced the radium and uranium content. It was also found that the radium in mill tailings is slowly soluble by water leaching. This indicates a problem that needs further study.

In addition to research and analytical work in the laboratory, the Winchester group directed a comprehensive survey of AEC's Monticello mill to determine problem areas and suggest improvements. Changes were made where concentrations were found to be above the standards of Part 20. The mill was resurveyed after the changes had been made. The results indicated that the dust levels to which mill employes are exposed can be brought within Part 20 limits by conventional ventilation equipment and procedures, by good housekeeping and by taking proper precautions to assure good hygiene.

Interim reports covering the work of the Winchester Laboratory were distributed to all of the mill operators, to Public Health Service and to various state organizations. In addition, two seminar meetings were held in Grand Junction, Colo., for technical discussions with representatives of the uranium milling industry. Also participating were representatives of Public Health Service, AEC's Division of Biology and Medicine, and state health organizations. These meetings, one of which was held in October, 1958, and the second in April of 1959, were of considerable value in acquainting industry with the potential radiation problems as well as affording an opportunity for a general discussion of the work performed by Winchester. The meetings were open to the public and the proceedings were reported by the local press.

Industry Radiation Problems

Speaking as a miner, let me attempt to summarize, on the basis of information developed by the investigations outlined above, the radiation problems of the uranium industry.

Mines. Many underground uranium mines have a radon product concentration much in excess of recommended permissible limits. The studies indicate that in most cases good ventilation, using conventional equipment, will reduce the concentration of radon and its daughter products to acceptable levels. This means good ventilation in all working areas. Some mines may have a difficult problem because of an insufficient number of shafts or other connections to the surface. Higher-grade uranium deposits create more of a radon problem than lower-grade deposits.

Representatives of the Public Health Service and AEC's Division of Biology and Medicine are of the opinion that mines having concentrations of radon products in excess of permissible limits may present a definite health hazard. However, an extensive medical examination program extending over a considerable period would be required to determine whether uranium miners have a higher incidence of lung damage than those employed in other mines or in other occupations.

Because of the large number of mines, many of them small and poorly-equipped, inspection and enforcement will be a major task.

Mills. Modern wet process uranium mills should have no serious difficulty in maintaining safe working conditions for employes. Proper dust collecting systems at the ore crushing and yellow cake sections should bring dust levels within AEC Part 20 limits. Good housekeeping and proper hygiene also are essential to prevent ingestion while eating and drinking. The danger from small quantities of concentrate in the digestive tract is more from toxicity than from radiation.

External radiation appears to present only minor problems. Both crude ore and uranium concentrate emit only low level radiation which is not considered dangerous under normal working conditions.

Major Mill Problem—Waste Disposal

The major problem of the mills is the disposal of waste products—effluent liquors and tailings. Effluent liquors must not be allowed to contaminate surface and underground water resources. Preliminary work by the Winchester Laboratory indicates that neutralization followed by barite treatment may effectively reduce the radioactive content of the waste liquors.

The water contamination problem is much greater for mills situated along streams than for those remote from streams, particularly if there are no underground water-bearing sands which are, or may be, the source of domestic or industrial water. A substantial number of our domestic mills are fortunate in being remote from streams.

Although only a small percentage of the radium content of the ore is dissolved in the course of processing, the radium remaining in the tailings is slowly water soluble. Also, the radium absorbed in barite is slowly water soluble. This indicates that in the absence of some chemical treatment which would make radium permanently insoluble, tailings should be stored in such a manner as to minimize water percolation as well as erosion. The precipitation of slimes by addition of lime and the proper distribution of the slimes in the tailings dams should retard or prevent percolation.

I have no doubt that the uranium industry will successfully solve its radiation problems and will meet the high standards which have been established for the protection of its employes and the public. The advances in metallurgy and mill design during the past five years have been outstanding. This young industry already has achieved a high place for metallurgical efficiency and advanced technology.

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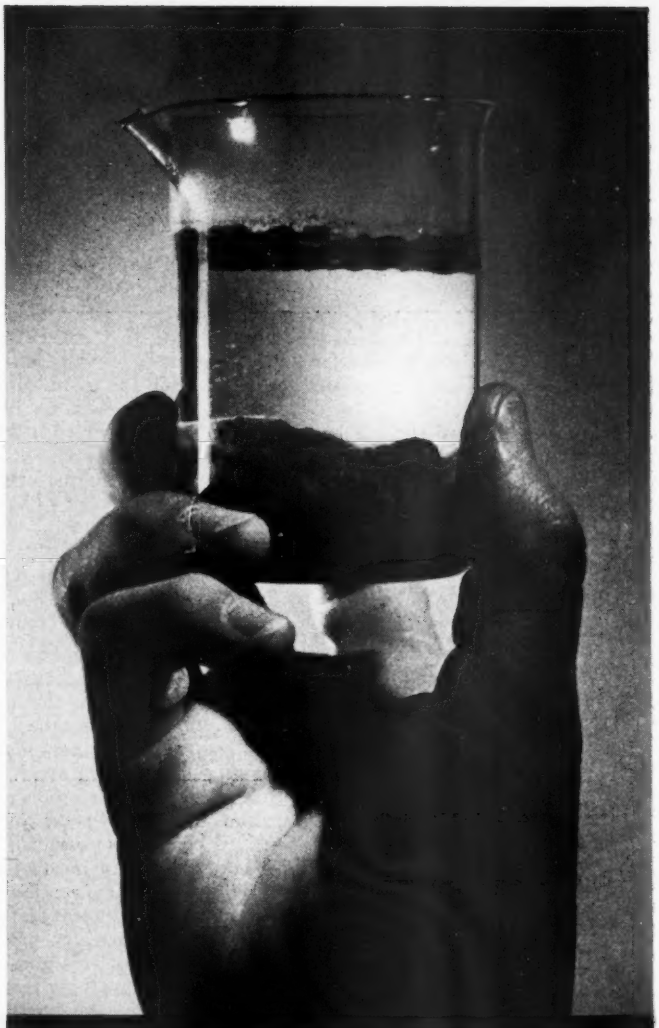

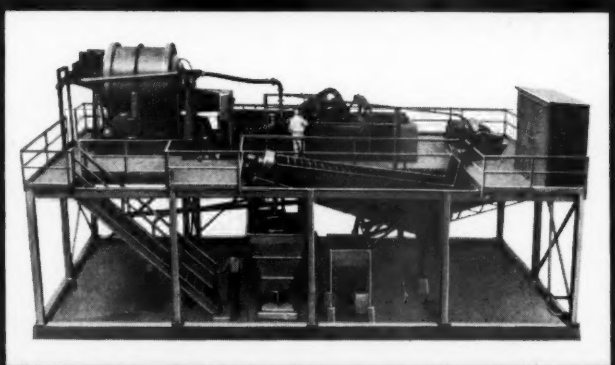

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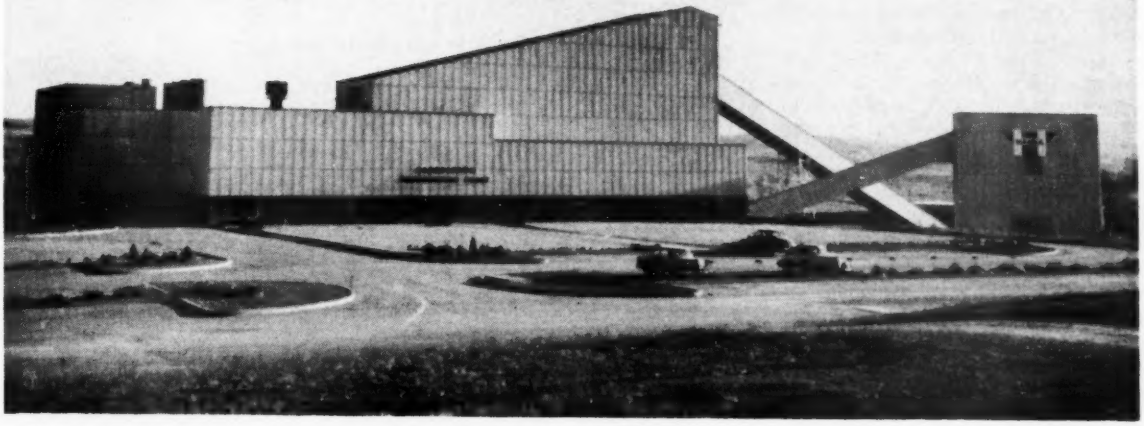
Using a basic approach to the problem of fine coal drying, the author develops a complete heat balance for a hypothetical case to arrive at the total heat input required and the fractions of the total heat needed for the various functions of the drying process. The article well illustrates the many factors which determine the size and operating efficiency of a dryer



Thermodynamics of Fine Coal Drying

By PAUL LEVIN
Allen & Garcia Co.

THIS article has been prepared to give the coal operator some idea of the type of calculation which must be carried out in the design of a coal dryer. It is not the intention of the writer to make this a manual for a "do-it-yourself" project in dryer design. The prospective purchaser of a coal dryer should refer his problem to qualified consultants or dryer manufacturers. The operator, however, should be aware of the many factors which determine the size and evaporating efficiency of his dryer.

CASE I

Let us begin by carrying out the heat balance calculations for a hypothetical dryer designed to dry a washed ¼-in. by 0 coal which has previously been dewatered by centrifuges and vacuum filters. It is assumed that the coal, at a tonnage of 200 tph, wet basis, will have a total moisture content of 11 percent and that it is desired to dry the coal to a moisture content of four percent. The following ambient conditions are also assumed:

Air temperature	70°F
Relative humidity	80%
Barometric pressure	14.7 psia (sea level)

First, the feed to the dryer is calculated to contain 178.0 tph of dry coal and 22.0 tph of water. The dryer products will have the same tonnage of dry coal, but only 7.4 tph of water. This gives a required dryer evaporation rate of 14.6 tph. Later in the calculations, it will be shown that this dryer will burn approximately two tph of coal in its furnace. This coal, assuming that it has a hydrogen content of five percent, will produce, on

combustion, about one tph of water. The water of combustion will increase the dryer's evaporation duty from 14.6 tph to 15.6 tph.

Next, the condition of the hot gases leaving the active drying area must be established. This is a function of the type of dryer being considered and depends to a large degree upon the experience of the designer. Other things being equal, a high relative humidity in the dryer exhaust gas will result in a high thermal efficiency in the process. On the other hand, with a high humidity exhaust, the dryer operates closer to the point of condensation in the exhaust ducts. If condensation occurs and is allowed to persist, the wet areas will accumulate dust, which in time will completely choke the ducts and dust collectors and put the dryer out of service.

For this problem, the gases leaving the drying zone will be assumed to be at 150° F and 70 percent relative humidity (RH). If a maximum temperature drop of 10° F is allowed in the dryer dust collectors and exhaust ducts, the gases leaving the dryer and entering the atmosphere or a scrubber will be at 140° F and 90 percent RH. The dewpoint of these gases will be 136° F. In other words, if the gases leaving the dryer bed are permitted to cool to 136° F before being discharged from the system, condensation will occur in the ducts. If design calculations indicate that excessive cooling of the gases in the dryer ducts is possible, insulation of the ducts may be required.

Having established the condition of the drying gases at the entrance to the furnace and then leaving the drying zone, the moisture carrying capacity of one lb of dry air will be computed at these points. In this case, one lb of dry air will hold 0.0125 lb of water vapor at ambient conditions, that is 70° F and 80 percent RH, and the same one lb of dry air will hold 0.1336 lb of vapor leaving the drying zone, at 150° F and 70 percent RH. The difference between these two values, 0.1211 lb, represents the quantity of water vapor which one lb of dry air will absorb in passing through the dryer.

Because the required evaporation rate is 15.6 tph of water, a total of $15.6 \times 2000 \div 0.1211 = 257{,}600$ lb per hr of dry air must be heated and blown through the dryer—plus, of course, its burden of water vapor.

There are various methods of carrying out the next phase of the calculations. In order to illustrate the procedure in detail, the total heat content of the various items entering and then leaving the dryer system will be computed (see tables I, II and III). The difference between heat content of the corresponding items is the heat required to be added to the dryer, in this case by a pulverizing-coal-burning furnace. In these calculations, 0° F is used as a base for coal and dry air; 32° F is the base for water and water vapor.

To the theoretical net total (table III) must be added an amount for radiation losses from the dryer and furnace and other furnace inefficiencies. In this illustration, ten percent will be added for losses which will increase the total heat requirements as shown in table IV.

Table I. Heat content entering dryer system

Dry Coal	
356,000 lb/hr × 70° × 0.25 Btu/lb/°F	= 6,230,000 Btu/hr
Water in coal—to be evaporated	
31,200 lb/hr × (70°–32°) × 1 Btu/lb/°F	= 1,186,000 Btu/hr
Water in coal—to remain in coal	
14,800 lb/hr × (70°–32°) × 1 Btu/lb/°F	= 562,000 Btu/hr
Dry air	
257,600 lb/hr × 70° × 0.25 Btu/lb/°F	= 4,508,000 Btu/hr
Vapor in air	
257,600 lb/hr × 0.0125 lb/lb × 1092.3 Btu/lb	= 3,517,000 Btu/hr
Total entering dryer	16,003,000 Btu/hr

Table II. Heat content leaving dryer system

Dry coal	
356,000 lb/hr × 150° × 0.25 Btu/lb/°F	= 13,350,000 Btu/hr
Water in coal—evaporated	
31,200 lb/hr × 1126.1 Btu/lb	= 35,134,000 Btu/hr
Water in coal—remaining	
14,800 lb/hr × (150°–32°) × 1 Btu/lb/°F	= 1,746,000 Btu/hr
Dry air	
257,600 lb/hr × 150° × 0.25 Btu/lb/°F	= 9,660,000 Btu/hr
Vapor originally in air	
257,600 lb/hr × 0.0125 lb/lb × 1126.1 Btu/lb	= 3,626,000 Btu/hr
Total—leaving dryer	63,516,000 Btu/hr

Table III. Heat required to be added in dryer furnace

Dry coal	13,350,000–6,230,000	= 7,120,000 Btu/hr
Water in coal		
Evaporated	35,134,000–1,186,000	= 33,948,000 Btu/hr
Remaining	1,746,000– 562,000	= 1,184,000 Btu/hr
Dry air	9,660,000–4,508,000	= 5,152,000 Btu/hr
Vapor originally in air	3,626,000–3,517,000	= 109,000 Btu/hr
	Net total heat required	47,513,000 Btu/hr

Table IV. Case I—Dryer heat requirement

	Btu per Hr	*% Distribution*
Heat dry coal	7,120,000	13.5
Evaporate water in coal	33,948,000	64.3
Heat water remaining in coal	1,184,000	2.2
Heat dry air	5,152,000	9.8
Heat vapor originally in air	109,000	0.2
Radiation and other losses	5,279,000	10.0
Total	52,792,000	100.0

The total heat requirement of 52,792,000 Btu per hr must be carried into the dryer by the 257,600 lb of dry air per hr computed earlier, plus its water vapor. Thus the air and vapor must be heated in dryer furnace to a temperature above ambient which can be computed as follows:

Temp. rise in furnace = (52,792,000 Btu/hr) ÷ (257,600 lb/hr × 0.25 Btu/lb/°F + 257,600 lb/hr × 0.0125 lb/lb × 0.45 Btu/lb/°F) = 801°F

Temperature of hot gases entering dryer bed = 70° + 801°F = 871°F

The volume of air required for the process at ambient conditions can also be calculated from the weight of dry air required in the dryer, correcting for its water vapor. Thus:

Table V. Case II—Dryer heat requirement

	Btu per Hr	% Distribution
Heat dry coal	7,120,000	8.9
Evaporate water in coal	55,492,000	68.9
Heat water remaining in coal	1,184,000	1.5
Heat dry air	8,422,000	10.5
Heat vapor originally in air	183,000	0.2
Radiation and other losses	8,045,000	10.0
Total	80,446,000	100.0

Table VI. Case I versus Case II

	Case I	Case II
Weight dry air	257,600 lb/hr	421,100 lb/hr
Temperature gases entering dryer	871°F	819°F
Air flow (at ambient conditions)	58,200 cfm	95,300 cfm
Furnace coal consumption	1.95 tons/hr	2.98 tons/hr
One ton coal fired will dry	103 tons	70 tons

Table VII. Case III—Dryer heat requirement

	Btu per Hr	*% Distribution*
Heat dry coal	7,120,000	13.8
Evaporate water in coal	33,948,000	66.0
Heat water remaining in coal	1,184,000	2.3
Heat dry air	3,988,000	7.7
Heat vapor originally in air	103,000	0.2
Radiation and other losses	5,149,000	10.0
Total	51,492,000	100.00

Table VIII. Case I versus Case III.

	Case I	Case III
Weight dry air	257,600 lb/hr	199,400 lb/hr
Temperature gases entering dryer	871°F	1075°F
Air flow (at ambient conditions)	52,200 cfm	55,500 cfm
Furnace coal consumption	1.95 tons/hr	1.91 tons/hr
One ton coal fired will dry	103 tons	105 tons

$$\text{Air volume} = \frac{(257{,}600 \text{ lb/hr})}{(0.075 \text{ lb/cu ft})} \times \frac{(14.7 \text{ psi})}{(14.7 - 0.29 \text{ psi})} \times \frac{(1)}{(60 \text{ min/hr})} = 58{,}200 \text{ cfm}$$

Assuming that the coal available for the dryer furnace contains 13,500 Btu per lb, the furnace coal consumption, then, is

$$\frac{(52{,}792{,}000 \text{ Btu/hr})}{(13{,}500 \text{ Btu/lb} \times 2000 \text{ lb/ton})} = 1.95 \text{ tph}$$

or expressed in another way, one ton of coal fired will dry 102 tons of wet coal.

CASE II

Now, going back to the origin of the drying problem, let us assume that instead of dewatering all the coal in centrifuges and vacuum filters, the operator dewaters his ¼ in. by 10-mesh coal on screens, the 10 by 28-mesh fraction in centrifuges and the minus 28-mesh coal in filters, giving a total plant product moisture of 15 percent. Assume also that the operator wants the same four percent moisture end product from the dryer and that the same tonnage of dry coal will be handled—that is, 178 tph.

Under the new conditions, drying 178 dry tph of coal from 15 percent to 4 percent moisture, an evaporation of 24.0 tph is required. Correcting for the water of combustion produced by burning an estimated three tph of coal in the furnace, the equivalent evaporation duty of the dryer becomes 25.5 tph of water.

Without attempting to develop the detailed calculations, which are similar to those in Case I, the total heat requirements of the dryer is found to be as given in table V.

As was to be expected, the heat requirements of Case II are appreciably greater than those of Case I, the major part of the increase taking place in the evaporation of water and in the heating of the dry air. If the percent of the total heat going into evaporation of water in the coal is considered to be an "efficiency" of the process, Case II is more "efficient" than Case I; that is, a greater proportion of the total heat in Case II is used for evaporation.

Table VI compares other important factors of the drying process.

It is interesting to note that although Case II requires considerably more heat input than Case I, nevertheless the temperature of the hot gases entering the dryer is lower for Case II; 819° F, as opposed to 871° F for Case I.

CASE III

Another case which may be worth studying involves drying at high altitudes. In Cases I and II, an operation at sea level was investigated—that is, with a barometric pressure of 14.7 psia. There is, however, a considerable tonnage of coal mined in the West at higher elevations. Let us repeat the calculations of Case I, but now, in Case III, the computations will be based on an altitude of 5500 ft above sea level, corresponding to a barometric pressure of 12.0 psia. All other conditions will be identical to those of Case I.

Due to the low barometric pressure at a higher altitude, a pound of dry air will hold more water vapor than at sea level. Thus, the moisture pick-up capacity of one lb of dry air, in passing through the dryer, is 0.1565 lb of vapor. This may be compared to the corresponding value of 0.1211 lb of vapor at sea level. As a result of the added moisture absorbing capacity of the air, the quantity of dry air required for the process at the higher altitude becomes 199,400 lb per hr, considerably less than for Case I.

The heat balance for Case III is given in table VII.

The heat balance is almost identical with that of Case I. The major difference is the reduced quantity of heat lost in Case III in heating dry air.

Other controlling variables in Cases I and II are compared in Table VIII. An interesting fact pointed up by the comparison is that the drying gas temperature in Case III is 200° F higher than the corresponding temperature in Case I. This, of course, follows from the fact that an attempt is being made to carry into the dryer approximately the same quantity of heat in both cases, but with a much lower mass of air in Case III.

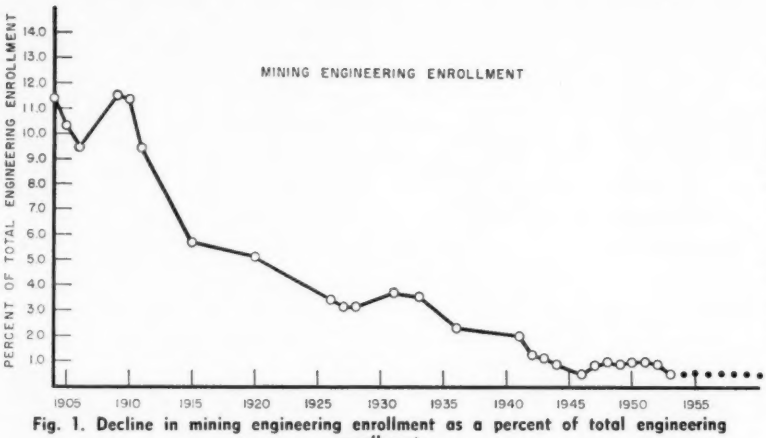


Fig. 1. Decline in mining engineering enrollment as a percent of total engineering enrollment

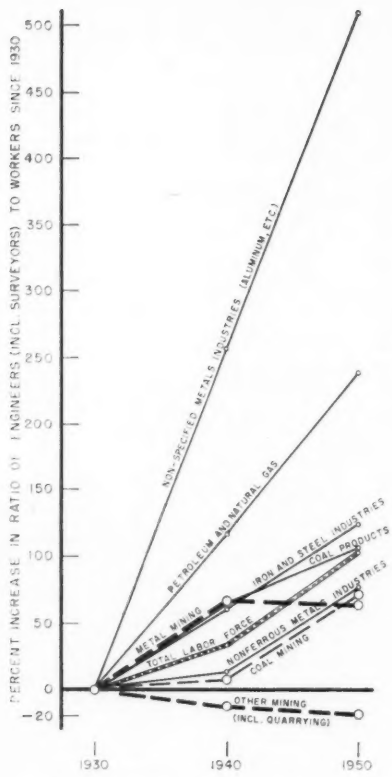


Fig. 2. Percent increase in the ratio of engineers (including surveyors) to workmen in specified industries and in the total labor force

A Proposed Survey of the Industry on Mining Engineering Curricula

Two Western mining professors analyze the needs of education in mineral sciences. Putting first things first, they point out that improvements in teaching facilities and in curricula are futile without first attracting more students into mining engineering courses and making the rewards for such study more inviting

By JOSEPH NEWTON
Head, Department of Mining and Metallurgy
and
JERRY M. WHITING
Assistant Professor of Mining
University of Idaho

LATELY there has been considerable discussion of what should and should not be included in a mining engineering curriculum. We believe the emphasis has been misplaced. If mining engineering curricula and teaching facilities at the undergraduate college level are to be improved, these two conditions are essential:

1. **More students must be enrolled.**
2. **There must be a sustained demand for mining graduates, with opportunities as inviting as those in other branches of engineering.**

The writers feel that all other considerations are secondary. Without these essentials there is no need to worry about curriculum, teaching loads, library facilities, graduate work, or other matters.

Key to Problem Concerns the Mining Industry

Better publicity is needed to increase enrollments in mining engineering; students in grade and high schools must be accurately informed about mining. Although the universities can help to attract high-quality students, the bulk of this public relations job will have to be done by the mining industry itself—which, in large measure, determines whether a mining career will be truly rewarding. If not convinced that the profession offers satisfying rewards, students will not enroll in mining engineering.

Figure 1 illustrates that for the past decade less than one percent of all engineering students were enrolled in mining. The statistics for this chart were taken from D. M. Blank and G. J. Stigler's, "The Demand and Supply of Scientific Personnel," published by the National Bureau of Economic Research in 1957.

Figure 2, based on other statistics from the same source, indicates the ratio of engineers to workers in various fields in 1930, 1940 and 1950. Note that the only downward trends on this chart are in "Metal Mining" from 1940 to 1950, and in "other mining" from 1930 to 1950. Other industrial fields, including the total labor forces, show marked increases.

Mining Executives' Help Requested

The Department of Mining and Metallurgy at the University of Idaho has prepared a questionnaire and distributed it to a number of key mining executives in an attempt to learn more about the problem of low enrollment and limited demand for Mining Engineers. Extra copies of this questionnaire are available to anyone interested in filling one out. It contains a number of blunt questions, and the college expects equally blunt and honest answers. A high return on the questionnaire will indicate that mining executives are interested in the problem; a poor response will be the most revealing and discouraging statistic of all.

(*Continued on page 107*)

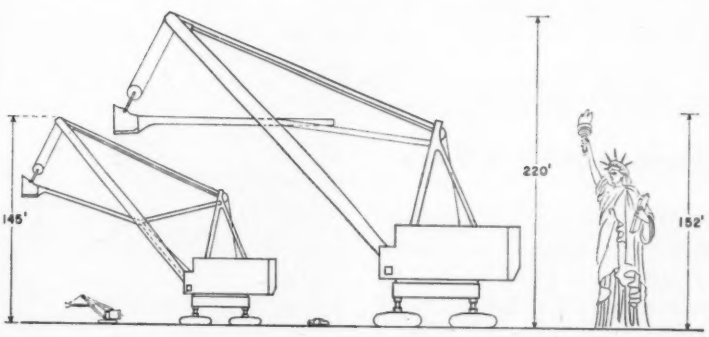
Peabody Orders Record Breaking Stripping Shovel for Kentucky Mine

A mammoth stripping shovel, the largest mobile land machine ever to be built, has been ordered by Peabody Coal Co., St. Louis, Mo., for a new mine in western Kentucky. The new shovel, which will be more than twice the size of any now in operation, will be built by Bucyrus-Erie Co., South Milwaukee, Wis.

To have a dipper capacity of 115 cu yd, a dumping height of 150 ft and a dumping radius of 212 ft, the new shovel will be capable of removing well over 100 ft of overburden. Expected to be in operation around August 1962, the machine will reportedly have the capacity to move 36,000,000 yd of overburden annually —more than twice the peak year production of the 77 shovels used in digging the Panama Canal. Total working weight of the machine will be 14,000,000 lb, and its 52 electric motors—ranging from ¼ to 3000 hp —will require 12,200 hp at peak demand.

The huge machine will be supported by hydraulic cylinders, one at each corner and will be mounted on four sets of dual crawlers. Each cylinder is independently and automatically operated to keep the machine at a level position at all times. The complete hydraulic system will require 4000 gal of fluid.

The mammoth machine will be controlled by one operator through two hand levers and two foot pedals. In 50 seconds, the machine will pick up 173 tons of material, dump it 464 ft away, and swing back for another task. The operator will be able to accelerate each load from 0 to 25 mph in eight seconds, decelerating from top speed to a full stop in four seconds.



Comparative Data:	Shovel Placed in Operation in 1955	Shovel to be Placed in Operation in 1962
Dipper capacity	60–65 cu yd	115 cu yd
Boom length	150 ft	216 ft
Weight	5,200,000 lb	14,000,000 lb
Height of boom point	145 ft	220 ft
Distance from ground to cab deck	24 ft	46 ft
Height of cab	36 ft	55 ft
Maximum dumping height	97 ft	150 ft
Maximum dumping radius	140 ft	212 ft

Comparative sizes, the 115-yd shovel, a 60-yd shovel, a 1-yd shovel, an automobile and the Statue of Liberty

Operators' Corner

Changing Frequency?

Check Your Antenna*

HERE is a tip which should prove very useful when changing operating frequency—always check the antenna to make sure that it will operate efficiently at the new frequency.

When changing frequency within the same band, (such as within the high band) a technician understands the changes required in the transmitter and receiver, such as crystal replacement and re-tuning. However, just as the transmitter and receiver must be tuned to accept one frequency and reject all others, so must the antenna, which is in itself a tuned circuit, be such that the new operating frequency falls within the frequency band of the antenna.

Remember, an antenna can: (1) deliver the RF power output the transmitter is designed for and (2) by using a gain antenna can actually add to the RF power output and increase talk-back range. However, with an improper antenna, and/or improper matching, the radiated RF power output can be reduced, seriously impairing radio system coverage.

Considering the many types of base station and mobile antennas in use, it is important to first note whether the present antenna can be tuned to the new operating frequency or whether it is a sealed, fixed-tuned antenna. All fixed-tuned antennas should be returned to the manufacturer for exact re-tuning. In cases where the antenna cannot be re-tuned to operate at the new frequency, a new antenna will be required.

This is the same for multi-element base station antennas, such as the corner reflector, isoplane and unipole. For these antennas it is not sufficient to merely cut the driven element to the proper length because the important factors of phase relationship and proper radiation pattern must be considered. This can be properly accomplished only by the antenna manufacturer. The manufacturer can re-tune the antenna, providing the new frequency is higher than the old frequency (higher frequencies use shorter elements, so they can be cut to size; lower frequencies require longer elements).

Mobile whip and roof-top antennas are considerably simpler in construction than base station antennas. These antennas can easily be modified to operate at the new frequency if the new frequency is higher than the old. In such a case, an antenna rod cutting chart should be obtained from the manufacturer before attempting to shorten the rod for operation at the new frequency.

For high band operation roof-top antennas are supplied in three pre-cut rod lengths, each covering a portion of the band. Therefore, when changing frequency within the high band and the new frequency falls outside the limits of the present antenna, a new rod should be ordered specifying the new operating frequency.

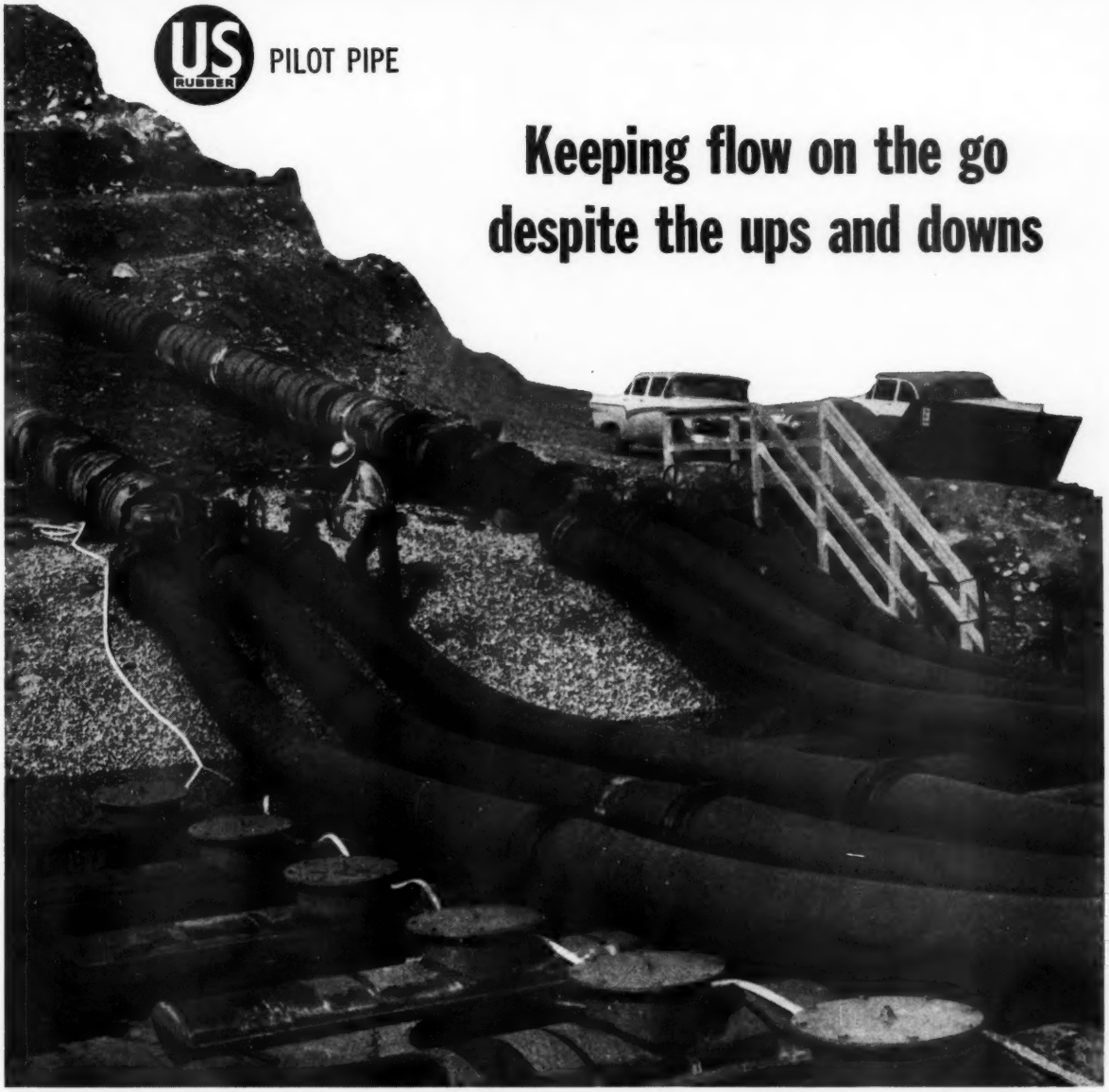
* Courtesy of *Motorola News Gram*, a Motorola, Inc., publication.

Balanced Welding Rig Speeds Up Mine Work

Adolph Doelling, machinist at the Venedy Coal Co., Venedy, Ill., fashioned this balanced welding truck that is all its name implies, and more—it is a labor and muscle saver. The secret of the rig is in the long pipe handles, which make pushing easy. At rest it is on an even keel, due to extended feet on the vertical handle rods. Doelling made the rig out of scrap material, plus an old auto rear-end and two used but serviceable tires and wheels.

US RUBBER PILOT PIPE

Keeping flow on the go despite the ups and downs



A taconite mining company in Minnesota operates 365 days a year, has capacity to produce 7,500,000 tons of iron ore pellets a year.

To produce a ton of taconite pellets requires over 100 kwh of electric power and 25 tons of water. This plant, at its present production rate, pumps almost 65,000 gallons of water a minute. It is utilized so carefully that the make-up water requirement is held to less than 5,000 gallons a minute.

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As Viewed by HENRY I. DWORSHAK of the American Mining Congress

CONGRESS, not the Tariff Commission, must decide what additional import restrictions, if any, are needed to put the domestic lead and zinc mining industry on a sound and stable basis, four of the Commission's six members in effect stated in a comprehensive lead-zinc report submitted March 31 to the Senate.

In refusing to make any recommendations, although specifically directed to do so in a Senate resolution adopted last August, Commissioners Talbot, Overton, Jones, and Dowling reiterated an earlier statement that a "careful and searching" review of pertinent legislative history and statutes had convinced them "beyond any doubt" that Congress deliberately avoided including among the Commission's functions and duties the making of recommendations or suggestions to Congress regarding the need for import restrictions.

They then indicated that the Commission's authority in the area of lead-zinc import restrictions is limited, under terms of the 1958 Presidential order imposing the current quotas on imports of lead and zinc, to determine what, if any, less restrictive treatment is warranted.

Commissioners Schreiber and Sutton disagreed with their colleagues. Stating that, in their opinion, there is no provision of law which forbids the Commission to furnish the information sought by the Senate, they proposed higher rates of import duties in lieu of the current quotas. These higher rates, they stated, "would be much more conducive" than quotas to the "successful operation of U. S. lead and zinc mines."

These rates of duty per pound were proposed: Lead metal, 3 cents (now 1-1/16 cents); lead in concentrates, 2.1 cents (now ¾ cent); zinc metal, 2.5 cents (now 0.7 cent); zinc in concentrates, 1¾ cents (now 0.6 cent); zinc content of zinc fume, 1¾ cents (now 15 percent *ad valorem*); and lead and zinc fabricated articles, various compensatory increases in present rates.

★ ★ ★ ★ ★ ★

Washington Highlights

TARIFF COMMISSION: Splits on lead-zinc findings

Fuels: Need for national policy stressed

PERCENTAGE DEPLETION: Early court decision sought

OIL IMPORT QUOTAS: Will not be adjusted

AIRBORNE WASTES: Oregon court decision stands

LEAD-ZINC: Hearings held on subsidy bill

GOLD: Inflation curbs urged to stem outflow

AIR POLLUTION: Bill would broaden Government role

★ ★ ★ ★ ★ ★

All six Commissioners agreed that "import quotas affecting such a large and complex industry as lead and zinc have not proved a satisfactory means of curtailing excessive imports of these metals." The current quotas, they declared, "being incapable of adjusting the changing elements of domestic supplies to the changing and varied needs of industrial consumers, have tended to increase, rather than to reduce instability of market prices, and thereby to thwart the best interests both of domestic producers and consumers of lead and zinc" and created unusual difficulties for some while bringing windfall advantages to others.

NEED FOR FUELS POLICY STRESSED AT COAL BANQUET

Indiscriminate sale of a small percentage of the world's fuels—dump natural gas and imported residual oil—is endangering the national welfare and security, George H. Love, chairman of the National Coal Policy Conference, told the Conference's annual dinner meeting March 30 in Washington, D. C. The banquet was attended by many members of the Congress, heads of Departments and agencies of the Federal Government, and hundreds of representatives of industry and labor.

The coal industry, Love said, has no quarrel with the domestic oil industry. "We believe the public should have a free choice to use gas, oil or coal, if these fuels are offered on a fair competitive basis. We believe we can convince the people of this country that it is in the public interest to establish a national fuels policy, so that all our fuels—oil, gas, atomic energy and coal—will play their proper places in energizing this great nation," he declared. He said the national security is threatened when unrestricted imports of residual oil and the sale of dump gas at less than production costs disrupts the coal industry, putting it and railroads serving coal producers on a "stand-by basis."

Love also emphasized that the coal industry is "not interested in 'end-use control'" and that the industry can show any Congressional Committee that all domestic fuels "should be maintained on some minimum basis, free to compete fairly in any market, and with the consumer making the final choice."

Controls on residual fuel oil imports are necessary, he said, to "protect and foster our nation's oil industry."

"Thus, our disagreement, if any, is not with the American oil producers, but with four or five international companies which would flood this country with residual oil from foreign sources permanently, and thus make this great eastern seacoast of ours completely dependent on such importation. The coal industry does not seek to shut off these foreign residual oil imports, but we ask that they be maintained on some normal basis."

The scheduled guest of honor at the banquet, John L. Lewis, president

emeritus of the United Mine Workers of America, was unable to attend due to the illness of his brother, A. Dennis Lewis, UMW District 50 president. UMW President Thomas Kennedy accepted a rare 1793 edition of Shakespeare from Love on Lewis' behalf.

GOVERNMENT SEEKS EARLY ACTION IN MINING TAX CASE

The Government is pressing for an early decision by the Supreme Court in *U. S.* v. *Cannelton Sewer Pipe Co.*, involving the percentage of depletion allowance for a producer of fire clay and shale sold in the form of vitrified sewer pipe, flue lining, etc. The lower courts held the depletion allowance was properly computed on the income from the sale of the finished products, but the Government contends it should be computed on the value of the raw materials before processing.

The Government filed its brief with the Supreme Court on March 25; the brief was accompanied by a 500-page compilation of historical material bearing on the question. It is clear that the Government seeks a decision which will not be confined to fire clay and shale—instead, the Government has asked the Supreme Court to consider the approaches previously taken in lower court decisions involving the "cut-off point" for other minerals, since the Supreme Court will, in this case, "be establishing criteria to which the lower courts will hereafter look in interpreting the statutory definition of 'mining.'"

The National Coal Association has filed a motion for permission to submit a brief in the *Cannelton* case, accompanied by its proposed brief, in which it urges the Supreme Court to avoid casting any doubt upon the fact that treatment processes listed in the law are allowable for depletion purposes without regard to any marketability test prior to the application of such processes.

The taxpayer's brief is due to be filed by May 6, and the Government will then have the opportunity to file a reply brief if it wishes to do so. The Supreme Court has scheduled oral argument in the *Cannelton* case for the week of May 16.

GOVERNMENT STANDS FIRM ON OIL IMPORT QUOTAS

Importers of residual fuel oil, which is subject to an import quota, should be "on notice" that the Interior Department has "no information which would appear to warrant an upward adjustment in the residual allocation" for the six-month period ending June 30, according to a top-level Department spokesman.

This notice was served by Elmer F. Bennett, Acting Secretary of the Interior, in a letter last month to Joseph E. Moody, president of the National Coal Policy Conference. Moody, in an earlier letter to Interior Secretary Fred Seaton, had expressed the concern of the coal industry over the high rate of competing residual imports during January and February and had asked whether any adjustment of allocations was planned.

In his reply Bennett stated, "In administering the program . . . we cannot in good conscience ignore the national security aspect and set the allocation level at a point which permits everyone who wants to bring in residual fuel oil and to bring in as much as he desires. . . .

"If those who have allotments under the program make the decision to so gear their import and sales policies as to exhaust their allotments substantially before the end of the allocation period, that is their right."

COURT REFUSES REVIEW OF INDUSTRIAL WASTE CASE

The U. S. Supreme Court has refused to review an Oregon court decision that may result in new legal perils for companies whose operations cause the spread of industrial wastes. By its refusal, the Supreme Court left standing a ruling which, according to Reynolds Metals Co., will put "a staggering burden on national defense industries and industries basic to the economy."

This case involved the company's legal responsibility for the discharge into the air of gases, fumes, and particles by its aluminum reduction plant near Troutdale, Ore. Neighbors of the plant took Reynolds Metals to court on charges that its industrial wastes, by settling on their land, made it unfit for grazing cattle. The Oregon court awarded damages to the neighbors, finding that the company in effect had trespassed on their land.

Reynolds Metals contended that the discharge of its wastes was, if anything, only a nuisance—a lesser legal offense. The Oregon court held, however, that even though the particles discharged from the company's plant were invisible to the eye, they still invaded the neighboring property and the company thus was guilty of trespassing.

In its attempt to secure review by the U. S. Supreme Court, Reynolds Metals said the Oregon court ruling could affect steel, oil, cement, and fertilizer producers and might even affect the Federal Government's atomic development program because of the spread of radioactive waste material.

HEARING HELD ON LIMITED LEAD–ZINC SUBSIDIES

Late in March the House Mines and Mining Subcommittee held two days of hearings on proposed legislation which would authorize the payment of Federal subsidies to domestic producers of lead and zinc ores whose annual sales in normal commercial markets do not exceed 5,000 tons based on metal content. The subsidies would be equivalent to the difference between the returns actually received by eligible producers and what the returns would have been at market prices of 17 cents per pound for lead and 14½ per pound for zinc.

After several Congressional sponsors of the measure testified in its support as a means of easing the plight of hard-pressed small miners, particularly in the Tri-State area and several Western States, Assistant Secretary Royce A. Hardy took the stand to present the views of the Interior Department.

While the Department would take no position until it had a chance to study an upcoming Tariff Commission report on the lead-zinc industry, Hardy said, the Subcommittee might wish to consider limiting subsidy payments to producers of not more than 500 tons of metal content annually. On the basis of 1956 production figures, this ceiling would still permit 80 percent of all domestic producers to qualify for payments, he stated, while the 5,000-ton figure would cover 95 percent of producers. He also suggested that the price bases in the bill "seemed higher than need be" to accomplish the measure's purposes.

Industry witnesses who testified were Tom Kiser, president of the Tri-State Zinc & Lead Ore Producers Association; Clark L. Wilson, chairman of the Emergency Lead-Zinc Committee; and Robert S. Palmer, executive vice president of the Colorado Mining Association.

Kiser endorsed the legislation as "the best possible solution for small producers" but declared that further import controls are necessary. Wilson said that while subsidy payments might provide supplementary protection to small mines, they would not solve the real problem—excessive imports which have denied domestic producers a fair share of the domestic market at equitable prices. Palmer said the "time has arrived when Congress should provide an incentive

plan for the small lead and zinc mines . . . for these are the ones that bring into production the large mines of the future."

Not present at the hearings but submitting statements for the Subcommittee's consideration were S. K. Droubay, vice president, United Park City Mines Co.; Henry L. Day, president, Day Mines, Inc.; and A. J. Teske, secretary, Idaho Mining Association.

Further hearings are scheduled.

INFLATION CURBS SEEN AS WAY TO SLOW GOLD OUTFLOW

Flow of U. S. gold to other nations, a matter of growing concern to Government officials in recent months, can best be slowed by resisting inflation at home rather than by curbing imports, cutting foreign aid, or changing the price of gold, according to Treasury Secretary Anderson.

The Secretary, who presented his views in an article in the quarterly magazine *Foreign Affairs*, called for a vigorous export drive by U. S. manufacturers to increase the flow of sales proceeds into this country, thus trimming the balance-of-payments deficit.

This country has been running a deficit in its financial dealings with other nations in recent years, reflecting an excess of outlays for imports, overseas capital investment, and foreign aid over income from exports and other foreign sources. As a result, U. S. gold holdings have fallen from $22.7 billion in 1950 to the current level of about $19.4 billion.

Secretary Anderson said he does not feel that we are "confronted with an emergency" by the balance-of-payments deficit, but that the deficits incurred in the past two years ($3.7 billion in 1959 alone) "were too large to be safely sustained for very long." He appealed for steps to bolster overseas confidence in the dollar so that foreign holders of dollars will not be frightened into converting them into gold.

Anderson called for such anti-inflation measures as a Federal budget surplus in the coming fiscal year, removal of the 4½ percent interest ceiling on long-term Government bonds, and a continued policy of credit "containment" by the Federal Reserve System.

GOVERNMENT SEEKS BROADER AIR POLLUTION STUDY ROLE

Legislation to broaden the U. S. Surgeon General's authority to investigate air pollution has been endorsed by an Administration spokesman in testimony before a House subcommittee on health and safety.

Secretary Arthur S. Flemming, who heads the Department of Health, Education, and Welfare, supported proposed amendments to the Federal Air Pollution Control Act which would (1) eliminate its 1964 expiration date and $5 million ceiling on annual appropriations and (2) authorize the Surgeon General at any time to make investigations and to hold public hearings on air pollution problems of "broad significance."

"Broad expansion of the assay and appraisal of State and local air pollution problems is highly desirable," Flemming declared. "During the past several years improved procedures for such assay and appraisal have been under development. In our opinion, this is primarily a responsibility of State and local governments. Such activities are so important, however, that Federal leadership and assistance should be available," he added.

Under the Act, funds are used for grants-in-aid to State and local government air pollution control agencies and to other public and private agencies and institutions and individuals for research, training, and demonstration projects.

The roof fall accident is the No. 1 man-killer in bituminous coal mines. In the quest for human life, this killer does not confine itself to particular mine areas. As can be expected, its biggest toll is taken in those areas where the most men work.

Ninety-five percent of all roof falls occur in producing areas . . . where the coal is cut, loaded, and conveyed . . . and where the many jobs incidental to the mining and transportation of coal are performed. Since more men work within 25 ft of the face than at any other single location, it is *here* that 75 percent of the men have been killed!

Over half of those deaths occur right at the face itself and beyond the last permanent support—a location where men work in a very small area. In most mines, this area approximates 180 sq ft, a relatively small space. In some mines, producing 1000 tons of coal or more daily, there are only 20 such small areas to control.

What overshadows all such description of accident sites is the fact that too many roof fall fatalities occur in mines where an approved support plan had been adopted, but where compliance was not strictly enforced!

It is obvious that in order to lower the accident fatality rate from falls of roof, much can and much must be done. Each of us can concentrate our efforts on:

1. Designing and inaugurating a good support plan, or improving the existing one.
2. Requiring strict compliance with the plan.
3. Designing the working face to limit man-exposure beyond the support line.
4. Controlling any necessary activity in the dangerous face area.

Management has the necessary tools with which to accomplish this task. Undeniably—planning, training, direction, and control are the implements to be used. The well-planned and well-controlled working face, manned with trained men, will result in fewer accidents, better organization, and less lost time. All this means better production, and more important, *lives saved!*

** Prepared by the Advisory Committee, 1960 National Campaign to Prevent Injuries from Roof Falls in Coal Mines.*

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personals

Clark L. Wilson, vice president of New Park Mining Co., has assumed chairmanship of the Emergency Lead-Zinc Committee, succeeding Miles P. Romney. Wilson, who will be headquartered in Washington, D. C., will devote full time to his new post. The Emergency Lead-Zinc Committee represents the interests of over 100 companies engaged in mining lead and zinc in the United States.

Edwin R. Phelps has been elected president of Pittsburg & Midway Coal Mining Co., succeeding the late Kenneth A. Spencer. A graduate of the University of Kansas, Phelps' career in the coal industry began in 1937 when he joined Southwestern Illinois Coal Corp. as an engineer. He later became assistant superintendent of the company's operations at Percy, Ill. Following 4½ years of service as a Naval officer during World War II, Phelps joined Constant Construction Co. as a construction superintendent. In 1948 he became associated with Pittsburg & Midway as an engineer and by 1953 had become vice president of operations, the position he held until his recent election as president. He is chairman of the AMC Coal Committee on Strip Mining, and is a member of several industry advisory groups.

George D. Weaver, formerly smelter and refinery superintendent, White Pine Copper Co., recently became general superintendent of surface operations. At the same time, the company announced that **L. A. Garfield** has advanced to the newly created post of general mine superintendent. Other changes include naming **F. B. Wercinski** to replace Weaver as smelter and refinery superintendent. Wercinski had been assistant superintendent. In the mining department, **Harold Raymond** became assistant general mine superintendent, and **M. P. Trainor** and **Leo Kauss** were named mine superintendents of the two subdivisions into which the underground work is now divided. **Carl Bailey** became maintenance superintendent in the mine organization.

Sheldon P. Wimpfen has been named executive assistant to the president, Reynolds Mining Corp. He had previously been assistant to the president of Western Machinery Co. A former editor of *Mining Congress Journal*, Wimpfen served from 1952 to 1956 as manager of the Grand Junction Operations Office, Atomic Energy Commission. He left the AEC to become a vice president of Glen Alden Corp.

Frank Nugent, president, Freeman Coal Mining Corp., and **Lester Crown,** president, Marblehead Lime Co., have been elected vice presidents of the parent General Dynamics Corp.

Harry Williamson, Jr., formerly superintendent at the Williams mine, Mountaineer Coal Co., was recently named general superintendent of mines, Freeman Coal Mining Corp. At the same time, **Thomas L. Garwood** was promoted from assistant to the vice president to chief engineer, and **Charles E. Sanford** was named industrial engineer.

Howland Bancroft has retired from the board of directors, Cerro de Pasco Corp., on which he has served since 1950.

J. Calvin Brantley recently was appointed director of research for Union Carbide Nuclear Co., division of Union Carbide Corp.

C. Kenneth Tudor has joined International Minerals & Chemical Corp., Carlsbad, N. M., in the newly created position of mine supervisor. He had previously been mine superintendent at Tazewell, Va., for Jewell Ridge Coal Corp.

Lloyd S. Campbell, assistant to the vice president of operations, Oliver Iron Mining Division, U. S. Steel Corp., was recently appointed vice president of the company's Michigan Limestone Division. It has been further announced that **J. N. Suliot** has succeeded **L. J. Patterson** as Northern District manager of Michigan Limestone. Patterson had earlier been named vice president—operations of Quebec Cartier Mining Co., a U. S. Steel subsidiary.

L. Campbell

Joe V. Kern has been named assistant to the resident manager for the Carlsbad, N. M., operations of United States Borax and Chemical Corp. The company also announces appointment of **Lewis A. Phillips** as chief industrial engineer at Carlsbad.

Richard B. Steinmetz has been elected to the boards of directors of Anaconda's two wholly - owned fabricating subsidiaries, the American Brass Co., and Anaconda Aluminum Co. He succeeds **Russel B. Caples,** retired from these directorships. A member of the Anaconda organization since 1929, Steinmetz was elected president of Anaconda Wire and Cable Co. in October, 1959.

R. Steinmetz

Glenn E. Allen has been appointed superintendent of Jamestown mines, Allied Chemical & Dye Corp.

Edward Day Dickerman was recently appointed senior metallurgist for the Western Division of Vanadium Corporation of America. Dickerman was previously associated with the National Lead Co. as technical supervisor in uranium concentration. Earlier, he held positions with Cerro de Pasco Corp. and Minerals Engineering Corp. VCA's Western Division mines and mills vanadium-uranium ore in the Colorado Plateau area.

A. C. Quine has been promoted to assistant to the vice president of the mining division, Utah Construction and Mining Co. He had formerly been general manager of Lucky Mc Uranium Corp., which was recently merged into Utah Construction. He will continue to manage Lucky Mc and will also direct the company's other activities in Wyoming's Shirley Basin uranium fields.

OBITUARIES

Robert Marion Hardy, 77, former president of Sunshine Mining Co., died February 21 in Yakima, Wash.

Mr. Hardy, a 1900 graduate of Louisiana Polytechnic Institute and a 1903 civil engineering graduate of Louisiana State University, began his professional career as a maintenance engineer with Vicksburg, Shreveport and Pacific R. R. He later joined Union Pacific R. R. and in 1907 left the company to become chief engineer for the Tanana Valley R. R. The following year he became resident engineer for the Alaska Railroad Commission, and in 1910 he took a position with the Washington State Highway Department as a division engineer. Mr. Hardy entered the construction business in 1911 and continued in it for about 12 years during which time he became interested in banking.

His banking career began in 1923, and he subsequently served as president and director of several Washington banks. He had been a president of the Washington Bankers Association, and was on the executive council of the American Bankers Association for three years. At one time he was the owner and publisher of a newspaper, the *Yakima Independent*. During World War II he served as a member of the War Production Board in Washington, D. C.

In the early 1930's, Mr. Hardy became actively interested in mining, and in 1934 he was elected president and director of Sunshine Mining Co. Under his leadership Sunshine became the leading silver mine in the United States. The company expanded and modernized its Idaho operations and diversified its interests in other mining areas as well as in successful exploration for and production of oil and gas in the Pacific Northwest and elsewhere.

For distinguished industrial and public service, Mr. Hardy was awarded a Certificate of Merit in technology from the State College of Washington Board of Regents in 1948. He was one of Washington's outstanding citizens, and worked tirelessly to develop the resources of the Northwest. During his career in mining, much of his time was devoted to betterment of the industry. He was chairman, for three terms, of the Western division, American Mining Congress, and was the guiding spirit behind the 1953 AMC Convention held in Seattle.

Horace B. Holland, 66, president of Imperial Smokeless Coal Co. and C. H. Sprague & Son Co., died in Boston, Mass., February 9.

Henry Shefelbine, 46, general superintendent of Hidden Splendor Mining Co. operations in the Big Indian District, Utah, was killed in a mine rock fall February 25 near Moab, Utah.

Bailey Neel, 52, vice president of Wise Coal and Coke Co., died in Norton, W. Va., February 26. Mr. Neel had joined Wise in 1957 after nearly 30 years with Stonega Coke and Coal Co. and associated companies in Virginia and Pennsylvania.

Kenneth A. Spencer, 58, founder and chairman of the board of Spencer Chemical Co. and president of Pittsburg & Midway Coal Mining Co., died February 19 in Miami, Fla., from complications following a heart attack suffered February 5.

Well known throughout the coal and chemical industries, Mr. Spencer was an outstanding industrialist and civic leader. He was graduated from the University of Kansas in 1926 and immediately went to work for Pittsburg & Midway as an engineer. His interest in improving production methods and developing new uses for coal distinguished him early in his career. He helped to develop a differential density cone process for separating impurities from coal and installed the first commercial unit in the Missouri-Kansas field. In 1936 he developed a process for recovering iron pyrites from mine refuse which was his first venture into the chemical business.

In 1939, realizing that coal could be utilized as a chemical raw material, Mr. Spencer, who was then vice president and general manager of Pittsburg and Midway, initiated a study leading to the establishment of an integrated chemical industry in the Tri-State District. In World War II the Government requested his company to accept the prime contract for constructing and operating the Jayhawk Ordnance Works—a synthetic nitrogen plant for the production of ammonia, nitric acid and ammonium nitrate.

Following the war, the operating company was reorganized as Spencer Chemical Co. with Mr. Spencer as president. The Jayhawk works was purchased from the Government and converted to peacetime operation for the production of fertilizer and other chemical products. The company has since expanded and become a leader in the chemical industry.

In December 1942, Mr. Spencer became president also of Pittsburg & Midway. Under his direction the company made substantial growth, with seven coal mines currently being operated in Kansas, Colorado, Arkansas, Missouri and Kentucky.

A firm believer in scientific research, Mr. Spencer was chairman of the board of trustees and one of the original founders of Midwest Research Institute and a trustee of the University of Kansas Endowment Association. He was active in the affairs of numerous coal and technical organizations, and was chairman of the Program Committee for the 1952 Coal Convention of the American Mining Congress.

Willard Jarrell, 52, division engineer with New River and Pocahontas Consolidated Coal Co., was killed in an automobile accident in Oak Hill, W. Va., January 27.

G. J. Ballmer, 62, recently retired general superintendent of mines, Chino Mines Division, Kennecott Copper Corp., died March 9 in Chino, N. M.

How far will a Yieldable Set yield?

In any discussion of the Yieldable Arch or Ring, the question is invariably asked: How far will the Arch yield? Answer: It is not unusual to have a Yieldable Arch set yield until the legs almost touch each other at the center.

Gives Ground Chance to Settle

That's the whole point of the Yieldable Arch; it is *normal* for the joints to yield. It's the old technique of letting the enemy beat himself. By gradually "giving" under excessive pressures, the Arch gives the overburden a chance to settle into a natural arch of its own, and thus bring forces into equilibrium. As soon as stability is reached, the Yieldable Arch holds the line. A set of Arches consists of curved, U-shaped sections nested together and overlapped enough to permit clamping with two U-bolt clamps at each joint. The clamps control the degree of tightness, and permit yielding when the forces exceed the load for which the joint was intended. Each Yieldable Arch set is tied to adjoining sets by means of horizontal struts, which add lateral rigidity to the structure.

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NEWS and views

Eastern

COAL DIVISION CHAIRMEN NAMED

Two new AMC Coal Division chairmen have been named. **Woods G. Talman,** assistant vice president, Coal-Staff, U. S. Steel

W. Talman

L. Ellison

Corp., has succeeded **Ralph E. Kirk,** Consulting Engineer, Birmingham, Ala., as chairman of the Committee on Mine Safety. **Lonnie D. Ellison,** chief mining engineer, Island Creek Coal Co., Holden, W. Va., has taken over the reins of the Committee on Roof Action from **Allan Brookes,** manager, Mather Collieries, Mather, Pa.

Woods Talman joined U. S. Steel's Tennessee Coal and Iron Division in 1937. Following World War II he returned to TCI as chief inspector, coal mines, and subsequently served as assistant to the general superintendent, Ore Mines & Quarries, and as assistant general superintendent, Coal Mines. In 1952 he was appointed assistant general superintendent of U. S. Steel's Gary and Lynch Districts — Coal Division, becoming general superintendent in 1954. In 1958 he was appointed assistant vice president, Coal-Staff of U. S. Steel, with offices in Pittsburgh. Long active in the safety movement, Talman was appointed by the Governor of Alabama in 1947 as a member of a committee which rewrote the state's coal mining law.

Lonnie Ellison joined the engineering department of Island Creek Coal Co. in 1937. He progressed through various engineering and operating departments of the large West Virginia and Kentucky coal producer, and was promoted to his present position of chief mining engineer in 1958. A registered professional engineer, Ellison has been active in the affairs of the Coal Division, serving as a member of the committee on Mine Ventilation, now a segment of the Committee on Mechanical Mining. He is a member and past director of the National Management Association.

Ralph Kirk was the first chairman of the Committee on Mine Safety, aiding in its organization in 1957. His guidance of the group along the engineering approach to safety added greatly to the value of the Committee's work and its acceptance by the industry.

Allan Brookes has been chairman of the Committee on Roof Action for the past five years and

R. Kirk

A. Brookes

spearheaded that group's work in reporting on advances in roof control and standardizing methods and materials.

Now Long-Airdox Co.

Assets of The Long Co., Oak Hill, W. Va., manufacturers of underground mining machinery, have been

acquired by Marmon-Herrington Co., Inc., Indianapolis, Ind. Marmon-Herrington has been active in the mining industry through ownership of the Airdox Co., Chicago.

The Long and Airdox companies will be operated jointly under the name of Long-Airdox Co. **J. B. Long,** former president of The Long Co., will be president and chief executive officer of the new company as well as vice president and director of Marmon-Herrington, of which the new company will be an operating division. **Paul C. Manley** will be vice president, Airdox products, and **Robert C. Nelson** will be vice president, Long products.

Under the new management, Airdox field salesman and engineers will handle Long and Airdox products. The Long sales force, principally specialists in capital machinery, will continue to operate from Oak Hill.

Long-Airdox cooperation is not entirely new. Airdox has marketed for over a year a line of coal drilling and roof bolting machines made exclusively for them by Long.

Tests on Ignition of Gas by Frictional Sparks

A series of recent tests by the U. S. Bureau of Mines has revealed that sandstone, shale, and several other materials encountered in coal mines can cause frictional sparks which can ignite methane.

The research on frictional ignition was conducted at the Bureau's laboratories at Pittsburgh, Pa., and involved

(*Continued on page 97*)

Your new plant or expansion idea

Raw materials available?

Market available?

Location correct?

Capacity adequate?

Readily financed?

Right time to build?

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• KE projects include work in Australia, Brazil, Ghana, India, New Zealand, as well as Canada and the United States. Assignments include iron ore concentrating plants, cement plants, bauxite and alumina processing plants and diatomaceous earth facilities.

5459-M

(*Continued from page 95*)

metals as well as rocks. Sparks capable of igniting gas were generated by rubbing sandstone against sandstone, shale against sandstone, sandstone against roof-bolt steel, and shale against steel. Although no ignitions occurred by impact of mine rocks or steel during tension breaks of roof bolts, or by pull tests of roof bolts through their washers and roof plates, the researchers commented that these should not be ignored as possible dangers.

"Because incentive sparks can be produced so readily and with so little expenditure of energy, it is virtually impossible to eliminate them in coal mining," according to the Bureau publication describing the research. "Gas ignitions by this source must be prevented by other measures. One of the most effective measures is adequate ventilation to prevent an accumulation of gas."

A copy of Report of Investigations 5548, "Frictional Ignition of Gas During a Roof Fall," by John Nagy and Edward M. Kawenski, can be obtained by writing the Publications-Distribution Section, Bureau of Mines, 4800 Forbes Ave., Pittsburgh 13, Pa.

Eastern Gas Schedules New Cleaning Plant

To process coal from its Federal No. 1 mine in northern West Virginia, much of which is used for steam generation in electric utility power plants, Eastern Gas and Fuel Associates will construct a new coal cleaning and preparation plant at Grant Town, near Fairmont, W. Va.

Designed by Eastern's engineering department, the 12,500-tpd plant will use dense media, tables and froth flotation. The facility represents the final stage in a major improvement and expansion program at the Federal Mine. The new shaft, skip hoist, and auxiliary equipment—including 8000 ft of underground mine track—were completed in 1958. Last year approximately 600 large mine cars were acquired.

Ground breaking for the new Federal plant is scheduled for this fall, with completion in the latter part of 1961.

Commercial Test Plan for Low Grade Iron Ore

Two leading iron ore producers plan to build the first two pilot plants in Minnesota to test the possibility of commercial processing of semi-taconite, a low grade ore. M. A. Hanna Co. will build a pilot plant costing close to $2,000,000 near Cooley, Minn., with a capacity of about ten tph of iron ore. The Oliver Iron Mining Division of U. S. Steel Corp., will build a similar facility with a capacity of five tph at Coleraine, Minn. Both locations are in the western portion of the Mesabi iron range. Each of the two pilot facilities will experiment with roasting processes to change the ore chemically to a magnetic form.

Addendum to Annual Review Issue

Swift & Co. is among the important producers of phosphate rock in Florida. This fact was inadvertently omitted from an article entitled, "Phosphate", in the February 1960 issue of Mining Congress Journal, p. 98. Swift's operations are at Bartow.

Princess Coal Acquires W. Va. Mine

Princess Coals, Inc., of Huntington, W. Va., has purchased the Sewell Coal Co. which operates the Panther mine at Marybill, W. Va. Sewell Coal Co. will retain its identity as a wholly owned subsidiary of Princess Coals, but will operate within the organization as the Sewell Division, consisting of the Sterling-Sewell and Panther mines.

William Crawford, vice president of operations for Princess Coals, will be in charge of the newly formed division.

Princess Coals now operates 11 producing mines through four operating divisions: The Princess, the Powellton, and the Sycamore Coal Divisions, and the newly formed Sewell Coal Division.

Eagle-Picher Consolidates Divisions

Effective January 1, 1960, operations of the Chemical Division and the Mining & Smelting Division of the Eagle-Picher Co. were consolidated in a new Chemicals & Metals Division. In addition to roasting concentrates for the Mining & Smelting Division, the Chemical Division processed zinc and lead concentrates produced by the Mining & Smelting Division. The Chemical Division also sold slab zinc, germanium and other rare metals produced by the Mining & Smelting Division. In most respects, the business of the two divisions was complementary and interrelated and constituted an integrated operation. According to the management, the consolidation should thus result in greater efficiency and economy.

Tennessee Corp. May Acquire Miami Copper Assets

Tennessee Corp., maker of fertilizer and other agricultural products, has made an offer to buy certain assets of Miami Copper Co., subject to a retained royalty interest in the copper ore reserves to be sold by Miami to institutional investors. If the offer is approved by Miami stockholders, Tennessee will immediately take over the operation of the Miami property in Arizona, as a division, utilizing the same Miami personnel.

Miami stockholders will receive seven-tenths of Tennessee common plus an estimated $50 in cash for each share of Miami. Five-tenths of a share of Tennessee common going to Miami shareholders will come from shares of this company already owned by Miami. The cash payments will be derived from Miami's own cash and securities on hand, together with cash proceeds to be received from sale of certain of its assets to Tennessee Corp. and from the sale of retained royalty interest.

Results of Maine Survey Project Published

Results of the third annual aeromagnetic survey project undertaken by the Maine Geological Survey have been published.

One booklet, "GP&G No. 4," covers an aeromagnetic and geologic reconnaissance survey of portions of Penobscot, Piscataquis, and Aroostook Counties, Me. The publication includes eight pages of descriptive text, base maps, magnetic plans and profiles, a geologic map, photo-geologic interpretation map, and aerial photo index. Price of the booklet is $1.15 plus 3¢ sales tax for in-state purchase.

"GP&G No. 5" is an aeromagnetic and geologic reconnaissance survey of the Sidney-Augusta and Gardiner Areas, Kennebec County, Me. Results of this survey are presented in a single booklet including 11 pages of text, base maps, magnetic plans and profiles, geologic maps, and aerial photo indexes. Price is $1.88 plus 5¢ sales tax for in-state purchase.

Both of these booklets are available at the office of the Maine Geological Survey, Department of Economic Development, Room 211, State Office Building, Augusta, Me. Make checks or money orders payable to the Treasurer of the State of Maine.

Industry Notables Honored at AIME Annual Meeting

The 1960 annual meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers, held in New York City February 15 to 17, was also the occasion to honor some of its members who have made outstanding contributions to the industry, and to introduce the incoming president for 1960, Joseph L. Gillson, recently retired chief geologist for E. I. duPont de Nemours & Co.

The highest honor that AIME can confer, election to Honorary Membership in the Institute, was bestowed upon Andrew Fletcher, chairman of the board, St. Joseph Lead Co.; Henry DeWitt Smith, retired vice president of Newmont Mining Corp.; and Willian Embry Wrather, retired director of the U. S. Geological Survey.

Other high honors conferred included presentation of the Erskine Ramsay Gold Medal to Raymond E. Salvati, president of Island Creek Coal Co. and American Mining Congress, for distinguished achievement in coal mining. Robert J. Linney, executive vice president, Reserve Mining Co., was awarded the William Saunders Gold Medal for his work in bringing about commercial mining and beneficiation of taconite iron ores.

Raymond E. Salvati (left), president of Island Creek Coal Co. and American Mining Congress, receives a certificate attesting his award of AIME's Ramsay Gold Medal from Howard C. Pyle, president of Monterey Oil Co. and outgoing AIME president

Charles McElroy White, chairman of the board, Republic Steel Corp., received the Benjamin F. Fairless Award for his contributions with respect to steel production from the top-pressure blast furnace. For achievements in furthering the art of mineral beneficiation, Norman L. Weiss, milling engineer, American Smelting and Refining Co., was presented the Robert H. Richards Award.

The Hal Williams Hardinge Award was presented to Samuel H. Dolbear, president, Behre, Dolbear & Co. for outstanding achievement in the field of industrial minerals. For "distinguished contributions to the advancement of mineral industry education," Lester Charles Uren, emeritus professor of petroleum engineering, University of California, received the Mineral Industry Education Award.

Louis B. Slichter, director of the Institute of Geophysics, University of California in Los Angeles, delivered the Jackling Lecture, "Need for a New Philosophy for Prospecting or How to Rig Prospecting Honestly," and received the Daniel C. Jackling's Award for pioneering work in applying the principles of geophysics to practical problems in mineral exploration.

Corrosion Course Announced

The Fifth Annual Appalachian Underground Corrosion Short Course will be held June 1, 2 and 3. This course is conducted annually at West Virginia University, Morgantown, W. Va., and is endorsed by the National Association of Corrosion Engineers and American Water Works Association.

This year's course will cover eight main groups of underground corrosion. Fifty-seven classes, 15 new papers, and 25 new speakers are scheduled. Along with classroom instruction, there will be field demonstrations of coating materials and instruments, exhibits and movies. A round table discussion covering underground corrosion is being planned for one evening session.

Information on the 1960 course can be obtained by writing John H. Alm, Publicity Chairman, Room 605, 2 Gateway Center, Pittsburgh 22, Pa.

AEC Awards Contract for Radiation Protection Measurements

A contract for development of methods to measure accurately very small amounts of radioactive materials in drinking water or air which might be taken into the bodies of people working in uranium mines, mills and refineries and atomic energy fuel processing plants has been awarded by the Atomic Energy Commission to Ionics, Inc., Cambridge, Mass.

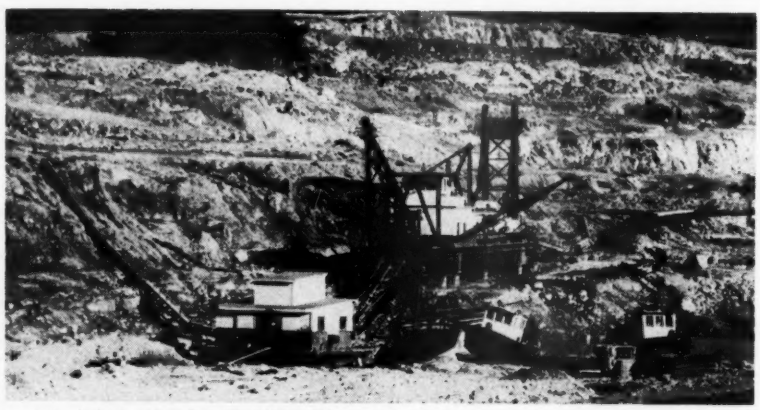
The $103,000 contract calls for determination of minute quantities of radium and thorium isotopes in solutions and solid residues. Since these radioactive elements will collect in varying amounts in human wastes and can often be related to the radiation dose received by an individual worker, analytical techniques applied to human wastes are also included in the scope of the work.

ALSO . . .

Armco Steel Corp. has signed a contract with Chesapeake & Ohio Railroad to haul coal at reduced prices. Armco will scrap its fleet of river barges. The C&O granted a reduction of 60 cents per ton on coal shipped from West Virginia mines to Middletown and Hamilton, Ohio. The price is based on a minimum shipment of 900,000 tons of coal per year. New rates make it substantially cheaper for Armco to ship by rail than to replace its fleet with new barges.

The Interstate Commerce Commission recently authorized the Southern Railway to establish a reduced rate on coal moving to a new power plant being built by Southern Electric Generating Co. at Wilsonville, Ala. Southern proposes to offer a rate of $1.35 per ton on large quantity movement of coal from mines at Gegco, Ala., northwest of Birmingham, to the Wilsonville plant. The present rate for the 118-mile delivery is $2.81 per ton.

Steep Rock Iron Mines, Ltd., will have a new major source of income beginning this year when the Caland Ore Co. mine begins shipping an estimated 750,000 tons of ore per year. The Caland mine at Steep Rock Lake, Ontario, is owned by Steep Rock Iron Mines and leased to Inland Steel Co. It will pay Steep Rock on a royalty basis. Ultimate annual output of the Caland properties is estimated at 3,000,000 tons, according to Steep Rock's annual report.



Black Lake Dredge Finishes Job

Having worked its way down more than 560 ft below the original level of Black Lake, Quebec, the $2,700,000 dredge, 'Fleur de Lis,' has been put up on stilts on the former lake bottom. What was once a 500-acre lake is now an open-pit asbestos mine, capable of producing 100,000 tons of fibre annually. The mine, and adjacent mill, are operated by Lake Asbestos of Quebec, Ltd., a wholly owned subsidiary of American Smelting & Refining Co. During its more than 51 months of continuous operation, the dredge pumped a total of more than 75 billion gal of water at a rate of 45,000 gpm. In addition, the machine removed over 31,029,000 cu yd of silt and overburden to uncover the asbestos deposit. The mine began producing in October 1958 with the dredge still pumping out the lake bottom.

Aluminum Company of America has revealed plans for a multimillion dollar research and development center which will be built over the next few years on a 2400-acre tract at Merwin, Pa. Foundation test borings are already underway, along with an analysis of the soil, to determine best building sites. Ground breaking for the first installation is to be started within a year.

Plans to construct a new enriched-uranium plant near Pittsburg, Kan., have been revealed by the U. S. Atomic Energy Commission. It has licensed Thor-Westcliffe Development, Inc., Santa Fe, N. M., to import seven gas centrifuges from Germany. These machines will be used in a pilot-scale study to determine the commercial feasibility of the centrifuge process for producing enriched uranium. The equipment will be shipped to New Orleans and stored there, pending AEC action on the Thor-Westcliffe application for a permit to construct the Pittsburg facility.

The Johns-Manville Co. has decided to reopen its surface mine and abandon underground mines for the production of asbestos at Asbestos, Quebec. Studies have shown that the mine-to-mill cost of a ton of asbestos for surface mines is considerably less than that for underground mines.

One of the largest shipments of coal in history —900,000 tons—is being moved from the United States to Argentina. Eleven vessels are being used to transport the coking coal from Hampton Roads, Va., to the $300,000,000 San Nicolas State steel mill. The mill is nearing completion 150 miles up the Parana River from Buenos Aires. The first carrier began its 6000-mile voyage last July, and the last shipment is scheduled to be completed in the spring of 1961.

Cyprus Mines Corp. has announced that one of its affiliates has reached agreement in principle with Billiton Co. of The Hague, Netherlands, to form a titanium pigment manufacturing company in the Netherlands. It will have an initial capacity of 10,000 tons of titanium dioxide annually.

Aluminum Company of America has ordered start-up operations at its new smelter at Warwick, Ind. The plant's capacity will be 150,000 tons of pig aluminum per year when five potlines are completed and operating, but the June startup pertains to the one potline that will be ready to go at that time.

A 1250-tph traveling coal-unloading tower for the Commonwealth Edison Co., Chicago, Ill., is scheduled to be erected by September 1, 1960. The unit will supply the company's Crawford Generating Station on the Sanitary District Canal and will be capable of unloading two 1200-ton barges moored abreast.

Iron ore cargoes dominated the shipping traffic on the St. Lawrence last year, with wheat and petroleum products in second and third place, according to a report of the St. Lawrence Seaway Authority for the 1959 season. Iron ore accounted for 30 percent of all shipments.

Kentucky Power Co., a subsidiary of American Electric Power Co., will build a 265,000-kw coal-burning electric generating plant five miles north of Louisa, Ky. The facility will consume about 750,000 tons of coal a year, all to be purchased from eastern Kentucky mines.

Pennsylvania's only uranium mine has been shut down. Located near Jim Thorpe, the Mauch Chunk Ridge mine began operation about five years ago, but the ore was not rich enough to win the Atomic Energy Commission bounty of $10,000. Also, there was not enough of it to warrant building a mill.

American-Marietta Co. became the Nation's seventh largest cement producer after papers were recently finalized for acquisition of Dewey Portland Cement Co., which has plants in Dewey, Okla., and Davenport, Iowa, and a third under construction near Tulsa, Okla.

Raleigh Pocahontas Mining Co., a newly organized concern, has purchased the outstanding stock of Lillybrook Coal Co. from Pocahontas Land Corp. Lillybrook's mines are the Affinity, Killarney, and Lillybrook No. 3, in Raleigh County, W. Va., which have been idle for several months. The company plans to reactivate Lillybrook No. 3, as soon as possible. Further plans call for a new preparation plant at the Affinity site and ultimately this plant would process the production of all three mines.

The provincial government recently announced a new, major discovery of asbestos in the Ungava region of northern Quebec. A diamond drilling program is said to have disclosed the presence of a large orebody. Site of the new discovery, which will add to Canada's stature as the world's largest producer of asbestos, is in an area often referred to as the "nickel belt" between Cape Smith and Wakeham Bay.

Electrical World's annual survey indicates that the utility industry consumed 0.89 lb of coal for each kwh generated in 1959—a decrease of 1.1 percent from the 0.90 lb reported in 1958. This means the coal consumption rate per kwh has been cut nearly one-third since 1947. The magazine says hydroelectric generation actually decreased last year, while fuel plant generation rose. Coal accounted for 66.2 percent of the fuel-generated electricity in 1959, gas 25.6 percent, and oil 8.2 percent. The survey found that utilities consumed 254,560,000 tons of coal and coal equivalent last year, an increase of 11.6 percent or 26,000,000 tons, over 1958.

American Metal Climax, Inc., recently announced the consolidation of its New York corporate and division offices in the American Metal Climax Building, 1270 Avenue of the Americas, New York 20, N. Y. Located at this address will be the offices of the corporation, its Amco Division, and those of Climax Molybdenum Co., Mining and Exploration Division, Southwest Potash Corp., and American Climax Petroleum Corp.

The Fourth International Congress on Coal Preparation is to be held in Harrogate, Great Britain, from May 28 to June 1, 1962. The organization of this Congress is being undertaken jointly by the National Coal Board and the Coal Preparation Plant Association.

Copper Products Development Association has elected to membership the following companies: Inspiration Consolidated Copper Co., O'Okiep Copper Co., Ltd., Tsumeb Corp., Calumet & Hecla, Inc., and Miami Copper Co.

NEWS and views

500 TPD Mill Planned

Camp Bird Colorado, Inc., owners of the Camp Bird mine near Silverton, Colo., has revealed plans for construction of a 500 tpd flotation mill at Silverton. The mill, which is scheduled to be placed in operation after completion in mid-September of this year, will recover lead, zinc and silver from Camp Bird mine ores. The mine had been under lease to other interests for 30 years prior to 1956, after which control of the property was restored to the company. At that time it was contemplated to reactivate the operation in 1957, but the plans were later curtailed because of metal market conditions. Recent mine development work has convinced the company that the operations can be profitably conducted despite the prevailing depressed condition of the lead and zinc industry. In addition to lead, zinc and silver, the concentrator will make some recovery of copper and gold values from Camp Bird ores. The company currently is reported to have a crew of about 50 men working at the property.

Shaft Lining Technique "Imported"

Tubbing, a technique new to the Western Hemisphere, will be employed in the shaft currently being sunk at the International Minerals & Chemical Corp. (Canada) Ltd., potash mine near Esterhazy, Saskatchewan. The technique, which has been successfully applied in many European deep shaft mines, employs a cast iron lining similar to those used in vehicular tunnels under rivers and lakes. The lining will be used to wall off water-bearing sands between the 1200 and 1500-ft levels of the shaft currently being sunk by IMC at Esterhazy. It will assure "long term efficiency and safety" in the operation. The shaft is now down to the 1200-ft level, where the sands are being consolidated by freezing, a technique employed in sinking the first 300 ft of shaft through glacial till.

The 300-ft lining, weighing 3000 tons, will consist of 65 rings, each five ft high, 18 in. thick, and 18 ft in diameter. Each ring is made up of 11 segments. IMC has approved a $750,000 contract with John Bertram & Sons to supply the lining, and a German firm, Haniel and Lueg, will direct its installation.

The Esterhazy deposit which is described as "the largest known deposit of high grade potash ore," is located at a depth of 3100 ft.

Cement Plant to Double Capacity

Plans for expanding and modernizing the Waco, Texas, cement plant of Universal Atlas Cement Division of United States Steel Corp. have been announced. Part of the program calls for installation of a second rotary kiln, which will double present plant capacity to an estimated annual capacity of over 2,000,000 bbl of finished cement. A special feature of the modernization program, which is scheduled for completion late in 1961, will be the installation of a complete glass-bag filter system for dust control. The Waco plant produces gray portland cement, masonry cement and a retarded oil-well cement.

Uranium Milling Contract Signed

Denver-Golden Corp., operator and 27-percent owner of the Schwartzwalder mine near Golden, Colo., has signed a five-year uranium ore treatment contract with Cotter Corp. Cotter owns and operates the Front Range mill at Canon City. The contract calls for minimum shipments of 15,000 tons per year of 0.70 percent U_3O_8 ore to the Cotter mill over the life of the contract. Denver-Golden reveals that about 55,000 tons of ore have been shipped from the Schwartzwalder since it was acquired, and that about 78,000 additional tons have been blocked out by exploration. The mine ranks among the four producers of the highest grade uranium ore in the Western Hemisphere. Denver-Golden, shortened its name from Denver-Golden Oil & Uranium Corp. in 1959. The original company began operations in 1955.

Geothermal Power Project

Pacific Gas & Electric Company's 12,500 kw power plant near Cloverdale in Sonoma County, Calif., is slated to be placed in operation during May. The plant, which utilizes geothermal steam from steam wells in Big Sulphur Creek Canyon, is said to be the first of its kind in the United States. Although eight steam wells were drilled in the area in the early 1920's for a similar proposed project, it was not until 1958 that sufficient interest had been developed to bring about construction of a power plant. At that time PG&E contracted with Magma Power Co. and Thermal Power Co., the producing companies, for erection of a power generating plant. The turbine for the plant is designed for operation at 100 psig and 348°F inlet steam conditions.

ALSO . . .

Two zinc mines in the Coeur d'Alene mining district of Idaho and one in Northeastern Washington are increasing production to assure an adequate supply of ore for the Bunker Hill electrolytic zinc plant at Kellogg, Idaho. Bunker Hill recently increased zinc production by reactivating a fifth electrolytic unit at the Kellogg plant. The two Idaho mines involved are the Bunker Hill and the Star, while the Washington operation is the Pend Oreille mine near Metaline Falls. Output at the Star has already been increased by 100 tpd to 950 tpd.

Operations have been suspended at the Texas Gulf Sulphur Company's Mexican sulphur plant at Nopalapa, Veracruz. Since production began in 1957, Nopalapa's output has averaged about 100,000 tons of sulphur annually, which represents less than four percent of the company's total average annual sulphur production. Relative to the company's other more efficient producing units, it was a high cost operation and the move was a simple matter of economy. Texas Gulf Sulphur is the world's largest producer of sulphur and as such operates four major Frasch plants in Texas and sulphur recovery plants at Worland, Wyo. and Okotoks, Alberta.

Progress is being made toward reopening of the Sunnyside mine near Silverton, Colo., which is under long term lease to Standard Uranium Corp. An 11,000 ft haulageway and development tunnel is currently being driven at the property. Development expenditures during 1959 were reported to be about $400,000; total estimated cost of the haulageway is placed at about $850,000. The property is expected to be in production early in 1961. Standard Uranium earlier had been reported to be planning erection of a $6,000,000 refining plant to process rhodonite from the Silverton area.

A sixth potline was recently placed in operation at Aluminum Company of America's Point Comfort, Texas, smelter. It will add 20,000 tons to the smelter's previous 100,000 ton annual production rate. The Point Comfort plant has a rated annual production capacity of 140,000 tons.

Globe Mining Company's 492 tpd uranium ore processing mill in the Gas Hills area of Wyoming is now on stream. The company uses the resin-in-pulp process to treat ore from an open pit mine adjacent to the mill and from another mine located about 12 miles away. Globe is a unit of Union Carbide Corp.

The State of Colorado is investigating the use of coal tar binders in paving materials. Encouraged by tests undertaken in Kentucky, the Department of Highways plans to use the binder in a 3000 ft test section in El Paso County. If the tests are successful and better roads result, use of the material could help to alleviate the state's depressed coal mining industry.

1960 AMC Mining Show Program Preparations Underway

Appointment of state and district chairmen for the National Program Committee, under the leadership of Oscar A. Glaeser, vice president and general manager, U. S. Smelting Refining and Mining Co., marks the beginning of that committee's work in formulating a program for the American Mining Congress Convention and Exposition to be held in Las Vegas, Nev., October 10–13.

Keeping abreast of developments in Government activity, as well as in operating technology, is becoming increasingly difficult in the ever more complex mining industry. But the men on the program committee are coordinating their efforts toward selecting the best qualified speakers to bring the full story of the status and progress of mining to convention-goers in the relatively short span of four Convention days.

National mineral policies, tariffs, taxation, safety, labor relations, public lands problems and other matters of Government policy will receive close attention. Operating sessions will set forth authoritative information from men in the field on exploration, underground and open pit practices and mineral beneficiation, in both metal mining and industrial minerals production.

And don't forget that this is an equipment exhibition year. Plans already laid by exhibiting manufacturers make it clear that the Mining Show will bring together the finest assemblage of modern mining equipment and supplies ever seen in the Western United States. Careful observation of the displays and conversation with manufacturers' representatives will provide a "refresher" and advanced course in mining equivalent to months of formal study.

NOW is the time to make your plans to attend. Requests for hotel reservations should be addressed to the AMC Housing Bureau, Convention Center, Paradise Road, Las Vegas, Nev. Processing of these requests will begin in May and the first assignments of accommodations will be made in June.

PROGRAM COMMITTEE

National Chairman: *Oscar A. Glaeser,* Vice-Pres. & Gen. Mgr., Western Operations, U. S. Smelting Refining & Mining Co.

STATE AND DISTRICT CHAIRMEN

Alaska: *Charles F. Herbert,* Consulting Mining Engineer, Anchorage
Arizona: *T. A. Snedden,* Mgr., Southwestern Dept., American Smelting & Refining Co.
Arkansas: *J. T. Watters,* Works Mgr., Mining Div., Aluminum Co. of America
California: *George E. Warren,* Pres., Southwestern Portland Cement Co.
Colorado: *Edwin H. Crabtree,* Dir., Colorado School of Mines Research Foundation, Inc.
Idaho: *William H. Love,* Gen. Mgr., Hecla Mining Co.
Montana: *E. D. Tierney,* Asst. Vice Pres., The Anaconda Co.
Nevada: *Joseph W. Wells,* Pres., Wells Cargo, Inc.
New Mexico: *M. F. Bolton,* Vice Pres., Kermac Nuclear Fuels Corp.
Oregon: *James H. McClain,* Mgr. of Manufacturing, Wah Chang Corp.
South Dakota: *Claude E. Schmidt,* Chief Met., Homestake Mining Co.
Texas: *W. P. Morris,* Pres., Duval Sulphur and Potash Co.
Utah: *Mitchell Melich,* Pres., Uranium Reduction Co.
Washington: *John Edgar,* Gen. Mgr., Mining Div., Sunshine Mining Co.
Wyoming: *Lee C. Grenier,* Gen. Mgr., Magnet Cove Barium Co.
Mississippi Valley: *Gill Montgomery,* Vice Pres., Flourspar Div., Minerva Oil Co.
Missouri-Kansas-Oklahoma: *Harold A. Krueger,* Mgr., St. Louis Smelt. & Ref. Div., National Lead Co.
Lake Superior District: *Robert J. Linney,* Exec. Vice Pres.-Operations, Reserve Mining Co.
Eastern States: *Herbert Z. Stuart,* Mgr. of Expl., Phelps Dodge Corp.
Manufacturers: *Albert E. Seep,* Pres., Mine & Smelter Supply Co.

Proposed Survey of Industry on Mining Engineering Curricula

(*Continued from page 82*)

From this study the University hopes to learn what the mining industry wants—so that it may adjust its mining engineering curriculum accordingly.

Comments for Consideration

Following are some pertinent observations by the authors; the results of the questionnaire should confirm, modify, or reverse them.

1. Decreased enrollment in mining engineering is not the result of any comparable decline in the mining industry—certainly, mineral production has increased over the years.

2. Some mining "engineering" jobs consist of years of routine surveying and mapping before a man is promoted to more interesting and remunerative work. In other cases there seems to be little or no engineering to be done above the level of "maintenance engineering."

3. Too many of Idaho's mining graduates have left the field after several years, to take up other work—machinery sales, municipal engineering, or academic work leading to a degree in some other branch of engineering. In almost every case the man made the change because he felt that it would improve his chances for advancement.

4. In Idaho's mining engineering curriculum the aim is to produce specialists in mining. It includes courses in mine surveying, mining methods, rock mechanics, ground support, explosives, mine plant design, and mine economics—in addition to basic sciences and humanities. We feel that specialized training sets the mining engineer apart from other engineers and equips him to do certain work more efficiently than they can.

5. The criticism that the mining engineer is a jack-of-all-trades, and that the mining industry wants more specialized engineers—electrical, mechanical, industrial, etc.—is not borne out by the data in figure 2, which includes all types of engineers. This chart indicates that the mining industry has not kept pace with other industries in utilizing technical manpower for the solutions of its problems.

6. As the demand for minerals increases, as production costs rise, as high-grade ores are exhausted, and as mechanized methods are more widely adopted, the mining industry will surely need more trained engineers. This is already the situation in coal mining.

7. The young engineer must be prepared to do his share of routine work such as surveying and mapping as he gains experience. But he should not do this indefinitely, nor should he be expected to do the work of technicians or secretaries. He must have the opportunity to work his way into more responsible positions. Management and engineering should become more closely integrated—as they have in other industrial fields. Today more and more mining is done with large, intricate machines, which require engineers to understand, direct, and control them. If mining is to keep pace with its sister industries, it will have to advance more trained mining engineers into posts where they help formulate policy.

8. At Idaho, recruiters coming to interview students for employment are interested in mechanical, electrical, chemical, metallurgical, and civil engineers, but only rarely in mining engineers. This is even true of recruiters from companies with large mining departments, who might be expected to show some interest in the graduating mining engineers. This makes it mighty difficult for the faculty to convince students of the advantages of a major in mining.

Employes at the H. B. mine of Consolidated Mining and Smelting Co. near Salmo, B. C., worked throughout 1959 without a single lost time accident. About 120 men are employed at the operation, 70 of whom work underground. The mine has not had a lost time accident since April 1958.

Lucky Friday Silver - Lead Mines Co. recently placed its new 500 tpd concentrator near Mullan, Idaho, in operation. Construction of the $500,000 mill, which is adjacent to the Lucky Friday mine, was started in May 1959. One feature of the mining operation is the use of mill tailings for back-fill in underground stopes which results in more efficient extraction of the orebody. The company also installed an underground conveyor to transport ore and waste from the shaft pockets to the surface, and track haulage was elminated. Lucky Friday is controlled by Hecla Mining Co.

A second rotary kiln is being installed at the magnesia refractory manufacturing facilities of Basic, Inc., at Gabbs, Nev. Upon completion of this and other construction plans, Basic will be able to supply a full line of special refractories to all steelmakers west of Chicago. The company has spent about $2,000,000 at Gabbs over the past two years enlarging production facilities and constructing a 500 tpd flotation plant.

The South Korean government-owned Korea Tungsten Co. reportedly is increasing tungsten ore shipments to this country as a result of an agreement reached with International Ore Corp., sales agent for the company in the United States. Shipments, currently at the rate of 300 tons per month, are being increased to 500 tons. Tungsten represented about one-sixth of Korean export earnings in 1959.

Wyoming's only sulfuric acid producer, Susquehanna-Western, Inc., has doubled its acid production capacity to 75,000 tons per year through construction of its second plant at Riverton. The newly erected facility, which is now in operation, will help to meet increased demands for sulfuric acid by ore processing mills recently constructed in the Riverton area. Sulfur for the plant is obtained from local Wyoming suppliers who recover it from sour natural gas.

A world's record for uranium ore production from an underground mine is claimed by Rio de Oro Uranium Mines, Inc., with a mark of 2016 tons mined December 2, 1959, at their Dysart No. 1 mine near Grants, N. M.

A $430,000 contract, which calls for production of 15,000 lb of high-purity vanadium, has been awarded to Oregon Metallurgical Corp., Albany, Ore. It is reportedly the largest package contract for high-purity vanadium ever let in this country. The metal will be produced for use by the Government. Oregon Metallurgical is the Free-World's largest producer of the high-purity variety.

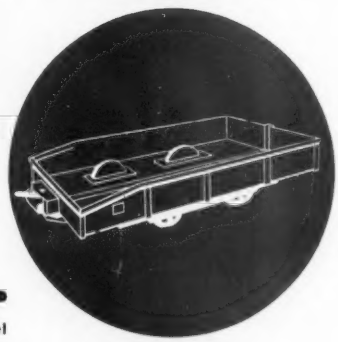
San Francisco Chemical Co. has made plans to reopen its Waterloo phosphate mill at Montpelier, Idaho, and to open a new mine in the area. The company has indicated that the 9000 ton per month rated capacity mill will be operated on a round-the-clock basis seven days a week when placed in operation about May 1. Ore will be trucked to the mill from the new Diamond Gulch open pit mine located on the Bear Lake and Caribou county line.

The 6th Annual Rocky Mountain Minerals Conference will be held in Salt Lake City, Utah, October 5, 6, and 7. J. M. Ehrhorn, industrial development director, U. S. Smelting Refining and Mining Co. is general chairman of the three day conference.

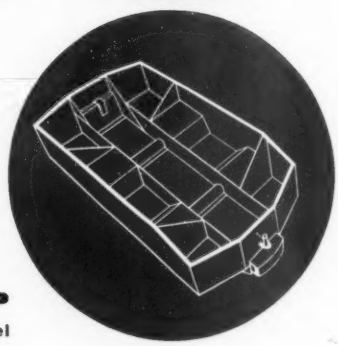
An additional step to broaden its product base has resulted in the Bunker Hill Co. announcement that it will enter the zinc oxide market on the West Coast, making it the only producer of the primary product in the Pacific area.

The Grand Junction Operations Office of the Atomic Energy Commission is interested in employing persons with combined experience in examining and evaluating mining properties, estimating ore reserves and analyzing mine production and cost data. A knowledge of geology and mining engineering is required. Experience in the uranium industry is desirable, but not required. Positions to be filled carry an initial salary rate of $7,510 or $8,810 per annum. Appointees receive the normal Federal employe benefits, including vacation and sick leave, and optional low-cost life insurance coverage. Further information and application forms may be obtained from the Personnel Branch, Atomic Energy Commission, Grand Junction, Colo.

DROP BOTTOM
4 wheel or 8 wheel



END DUMP
4 wheel



ROTARY DUMP
4 wheel or 8 wheel

acf MAKES ALL THREE

No matter what type of car your mining operations call for acf has a car to fit your needs. acf mine cars are built in all types and sizes from 2 to 30 tons, or more.

For safety, low maintenance and high speed constant haulage all acf mine cars have special features developed through many years of experience in design and manufacture.

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Kaiser Aluminum & Chemical Corp. is reportedly preparing to reactivate a sixth potline at its Mead Reduction Works near Spokane, Wash. The Mead plant, which has eight potlines, has a rated capacity of about 175,000 tons per year. Kaiser has primary production capacity in excess of 600,000 tons per year from its works at Mead and Tacoma, Wash., Chalmette, La., and Ravenswood, W. Va.

Technical reports on all phases of the uranium industry are to be presented at the AIME Uranium Section annual symposium to be held at Moab, Utah, May 6–8.

National Gypsum Co. reportedly plans to acquire Union Gypsum Co. of Phoenix, Ariz., through an exchange of about 77,000 shares of authorized but unissued National Gypsum stock, which at the current market price would be valued in excess of $4,000,000. Union produces wallboard, lath and plaster from gypsum mined at a deposit near Winkleman, Ariz., for markets in California, New Mexico, Texas and Arizona. National has 60 plants in 24 states and Canada and manufactures 11 different lines of related building materials.

Exploration for mercury in Yolo County, Calif., will be undertaken by Trans-Pacific Metals, Inc., in connection with a recent agreement made by the company with the Office of Minerals Exploration, Department of the Interior. The company is authorized to spend up to $34,340 on exploration work in Yolo County, one-half of which will be contributed by the Government.

Grouting and shaft repair operations are under way at Potash Company of America's Saskatoon, Saskatchewan, potash property, where production had been suspended in November due to water seepage into the shaft. Although it had been anticipated that trouble spots would require attention, subsequent additional water flows led to a decision to grout the entire shaft length including the water bearing Blairmore formation. The entire job is expected to take up to one year to complete and to cost about $900,000.

The Wyoming Mining Association's annual convention will be held June 9–10 at Jackson Lake Lodge, Grand Teton National Park, Wyo. Reservations may be made by writing Grand Teton Lodge Co., 209 Post St., San Francisco 8, Calif.

The Page mine of American Smelting & Refining Co., near Kellogg, Idaho, was recently named winner of the State Class A mine safety award for 1959. The award is given annually to the major mine in the State of Idaho with the best safety record. Clayton Silver mines, near Clayton, was given the Class B award for smaller mines.

Production of zinc will be resumed at the Kearney and Pewabic mines near Hanover, N. M. A recent diamond drilling program revealed some new and higher grade ore bodies at the properties. The mines, which are jointly owned by Hydrometals, Inc., and American Zinc, Lead & Smelting Co., had been closed for the past three years.

Book Review

Rocks to Riches.
Charles H. Dunning with Edward H. Peplow, Jr., Southwest Publishing Co., Inc., Phoenix, Ariz., $8.75.

Containing a wealth of information, this highly readable book accurately and concisely traces the history of mining in Arizona from its infancy through nine time periods, with emphasis on important developments during each period. As the leading State in production of non-ferrous metallic minerals, it is appropriate that the story of Arizona's mining industry has now been chronicled—and by a mining engineer with 50 years experience in the State.

A section is devoted to some of the complex problems and challenges facing the industry, as related to maintaining mining as a vigorous and healthy segment of the domestic scene. Another section illustrates how mining in Arizona has contributed to the growth of the nation and the future role it may play. A glossary of terms is included as is a descriptive listing of over 200 mines each having a recorded production in excess of $100,000. The author summarizes technological advances which have permitted conversion of formerly worthless waste rock into vast reserves of valuable ore.

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The Only Self-Loading Transport!

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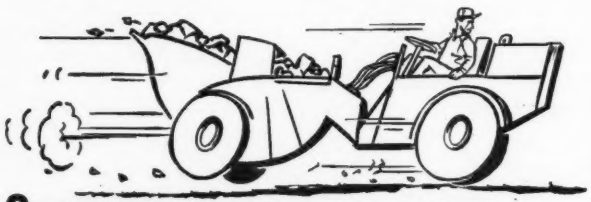
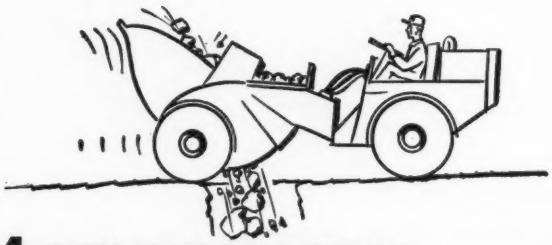


2. TRANSPORTS AT SPEEDS UP TO 23 MPH — *either direction!*



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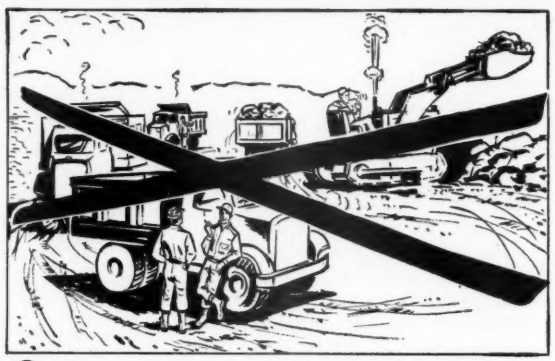

3. NEVER WAITS ON OTHER EQUIPMENT! S-D Transloader saves labor and machine costs wasted in multiple machine operation.

5. NO TURNAROUNDS REQUIRED! Returns immediately to reload! Travels at higher speeds than other equipment because of low center of gravity and articulated steering!

THIS IS WHY the S-D Transloader is more efficient than conventional equipment and methods of materials handling. But this is not all. The S-D Transloader way is the **lowest possible cost way** because:

1. **LOWEST ORIGINAL COST** for tons handled!
2. **LOWEST MAINTENANCE** due to extremely simple design and high quality of components . . . such as T-1 Steel, Cummings Engines, Clark Axles, Allison Transmissions!
3. **LEAST VENTILATION** required underground due to low horsepower ratio to work-done!
4. **LOWEST LABOR COST PER TON!** Incentive systems fit the S-D Transloader like a glove because of solo operation! Nothing could be neater than an operator loading and running a known distance to discharge **by himself!** This RELEASES SUPERVISION! S-D Transloader also ELIMINATES TASK OF TRYING TO BALANCE MEN AND EQUIPMENT WITH CONSTANTLY CHANGING SITUATIONS!

Write us today for Complete Packet of illustrated literature, data and time studies on this remarkable machine —

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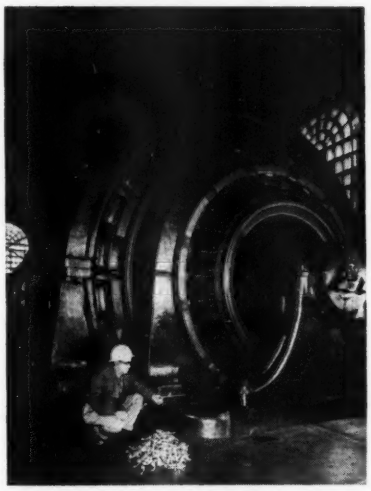
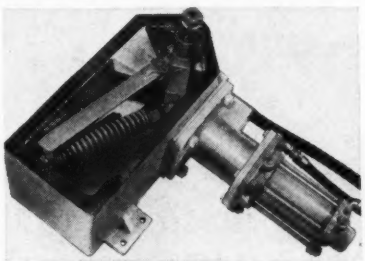


A COMPACT AC-TO-DC CONVERTER that delivers 6000 kw of power from 312 silicon rectifier cells is the result of a three-year joint development by Westinghouse Electric Corp., and Aluminum Company of America. Approximately 60 percent of the entire weight of the assembled converter is aluminum. The 10,000 amp converter has been installed at Alcoa's Badin, N. C. smelter, where it is supplying power for the aluminum smelting process.

BARNSTORMING trip is started by new 88-ton capacity dump car designed and built by Eddystone Division of Baldwin-Lima-Hamilton Corp., Philadelphia 7, Pa. Bright red prototype is shown leaving Eddystone, Pa., plant on 6000-mile demonstration tour that will take car to major ore processing centers across the country. New car is first of its kind designed specifically to handle copper concentrates and other ores without loss due to leakage. It is expected to reduce the cost of unloading cars at smelters.

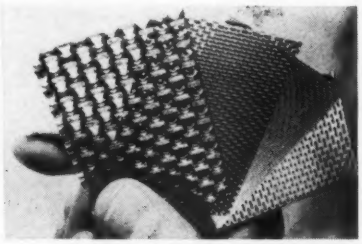
A LOW COST EPOXY TOOLING AND REPAIR COMPOUND has been introduced by Devcon Corp., Danvers, Mass., in two types, Devcon 100 — a putty-like material, and Devcon 101 — a liquid. Both materials are said to have good tensile and compressive strength, to resist most chemicals and oils, and to bond to all types of metals, wood, ceramics and other materials.

AN AIR POWERED switch thrower called the Canton Aero-Throw is designed for mines where only compressed air is available, or preferred, and reportedly has all the mechanical advantages of the electric model. Simplicity and low maintenance are



reported features. This equipment was recently used in the construction of a railroad on the U. S. Atomic Energy Commission's test site in the vicinity of Mercury, Nev. Additional information may be obtained from the American Mine Door Co., 2063 Dueber Ave., Canton 6, Ohio.

ELECTRIC SUBMERSIBLE PUMPS manufactured in a range of sizes from 1½ to 8 in., with capacities to 3100 gpm, at heads to 220 ft, are offered by Flygt Corp., Hoosick Falls, N. Y. These pumps go right into the water to provide all-head performance from the bottom up, which is especially effective in deep, cramped sumps and shafts. There are no intake hoses or couplings, no check valves and no suction parts. Impeller is under water, providing pumping action as soon as the electric switch is thrown. Economy is pointed out as another feature inasmuch as they can be handled by a single man, can pump all day and night without supervision and are said to require only occasional inspection.

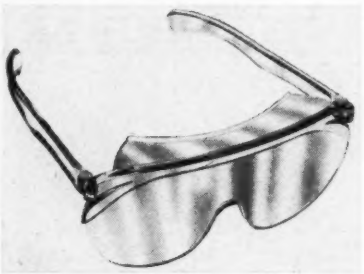


A NEW PIERCED METAL SHEET known as Conidure and made by a patented process has been introduced by Cross Perforated Metals, National-Standard Co., Carbondale, Pa., for screening and dewatering application. Longer life and greater throughput efficiency are claimed.

Conidure is made by a patented process licensed to National-Standard. Trapezoidal holes are pierced in sheets of carbon steel, stainless steel, copper, brass or aluminum. Sheet thickness can be up to seven times hole diameter. Hole diameters range from 0.004 to 0.099 in., and sheet thickness range from 0.014 to 0.079 in. The working side of Conidure is available in several degrees of smoothness, from unrolled to rolled flat with electrolytic polish. Selection of finish and hole size depends on the application.

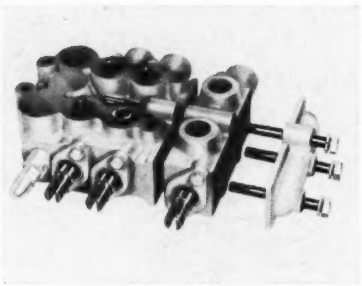
THE CARBON-ARC LEAD BURNER is designed for making emergency, on-the-job repairs to industrial storage batteries and for general heating jobs. Power for the flameless electric burner can come from the battery being repaired, if sufficiently charged, or from an ordinary six-volt automobile battery. For more information, write to Exide Industrial Division, Electric Storage Battery Co., Rising Sun and Adams Avenues, Philadelphia 20, Pa.

LIGHT WEIGHT BUT EFFECTIVE INDUSTRIAL EYE PROTECTION that can be worn all day with ease and comfort—even over prescription glasses— are reported features of a new VS3 Visitor Spec. from Willson Products, Reading, Pa. It weighs less than one ounce and can be worn for frontal eye protection against light impacts, foreign particles, or dust hazards. The wide brow rest and 0.080-in. thick lens is of one piece construction for more sturdy, dependable service. Library type temples are universal fitting for any size or shape of head. These glasses can also be used for eye protection for anyone working with wood, buffing, spot welding, inspections, and in other similar situations.



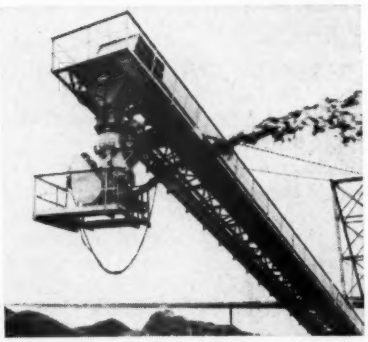
A LINE OF SINGLE-CYLINDER, SINGLE-ACTING HYDRAULIC RAMS recently announced by Owatonna Tool Co., 635 Cedar St., Owatonna, Minn., is available in nine sizes from a ram only 1-11/16 in. long with ⅝ in. stroke to a 20¼ in. long ram with 13½ in. stroke. Capacities are from 2 to 50-tons with maximum working pressure of 8650 and 10,000 psi.

A GENERAL PURPOSE VALVE employing the sectional principle, the V-34 Series Hydreco Valve is designed for use on lift trucks and other mobile equipment where supplementary operations are frequently added to standard models, according to the Hydreco Div., The New York Air Brake Co., 9000 E. Michigan, Kalamazoo, Mich. The basic V-34 Series Valve is composed of a two-plunger cast-in-block section with integral pilot-operated relief valve. All mounting holes, pump and tank connections are in the basic section. Additional operating sections may be added to the valve in the field as required without disturbing the original piping connections.



REPORTEDLY INCREASING CONVEYOR STORAGE RANGE up to ten times, the Swivel-Piler just announced by Stephens-Adamson Mfg. Co., Ridgeway Ave., Aurora, Ill., is said to be capable of throwing material in any direction over an arc of 270° when mounted on the discharge end of a storage conveyor. This feature allegedly eliminates frequent shifts of the storage conveyor system which saves time, equipment and money in materials handling operations.

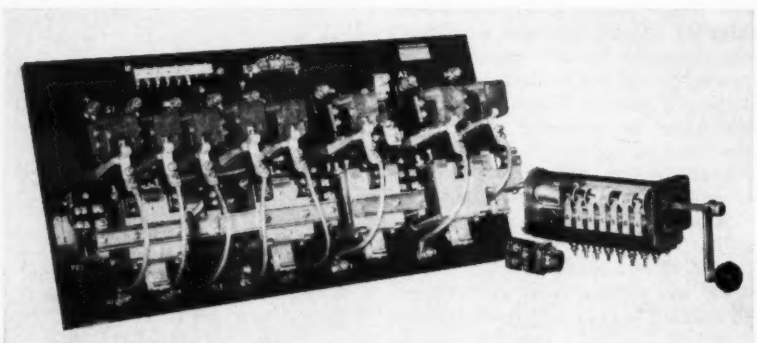
The S-A Swivel-Piler for conveyor mounting is an adaptation of the S-A Centrifugal Car Loader and Swivel-loader and consists of a centrifugal thrower unit complete with hopper and swivel-joint. The device can be mounted as a unit beneath the discharge end of practically any portable or fixed belt conveyor.



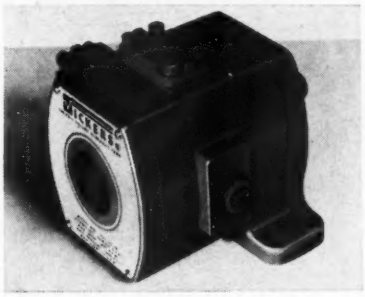
The thrower features a short, endless high speed conveyor belt which operates on centrifugal action principle. Material traveling at a high speed is thrown from the unit in any desired direction.

A SEMI-AUTOMATIC CONTROL developed by Allis-Chalmers Mfg. Co., Milwaukee 1, Wis., for man mine cars is said to permit safer and speedier trasnportation of miners to their job sites. The new device consists of a control panel, a remote pistol grip master switch, and a dynamic brake pushbutton for slow-down action on slopes.

A new safety feature is the control's forward-off-reverse master switch which is designed to return to the "off" position if the operator removes his hand from the grip. All controls are contained in permissive (explosion-proof) enclosures. This device is currently being used in man cars powered by 7½ and 15-hp, 250-volt d-c motors to provide automatically controlled acceleration at speeds from four to five times faster than the conventional mine locomotive. With its use the operator need only select the desired speed and direction of the car.

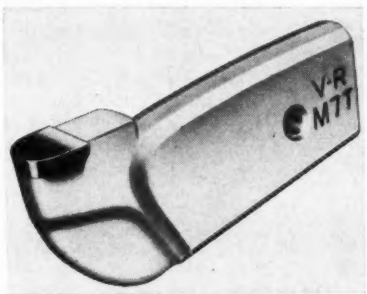


NEW SIX GPM VARIABLE VOLUME VANE PUMP announced by Vickers Inc. 18845 W. McNichols Rd., Detroit 19, Mich., automatically limits its delivery to system demand



at preselected adjustable pressures. The new pump is reportedly ideally suited as a fluid power source for varying volume demand circuits. Nominal six gpm rating is at 1800 rpm. Designed for use at operating pressures up to 500 psi maximum, it is available in flange, foot or gasket-mounted models.

A NEW STYLE CHAIN CUTTER BIT for auger miners is being announced by Vascoloy-Ramet Corp., 800 Market St., Waukegan, Ill. Des-



ignated as the style M7T, this recent addition to the V-R Red Bit line provides double locking security by combining the holding power of a taper type shank and a retainer pin. The cut-away nose shape is said to reduce drag and regrinding time to a minimum.

—ANNOUNCEMENTS—

Joy Mfg. Co. executives were honored recently at a banquet held in Pittsburgh at the Duquesne Club. The gathering was to celebrate lengths of service to the company ranging from 20 to 35 years. Those present included, with their years of service in parenthesis, the following: **Walter M. Jones,** district manager, Coal Machinery Div., St. Louis, (35); **Louis C. Rhodes,** district manager, Mining & Construction Div., San Francisco, (35); **Roy E. Campbell,** director of advertising and sales promotion (30); **W. Herman Van Houten,** assistant to president (25); **Arnott J. Lee,** district manager, Mining & Construction Div., Chicago, (25); **Walter G. Hutz,** sales engineer, Coal Machinery Div., Pittsburgh, (20). Since this meeting, Rhodes has been granted an extended leave of absence, and Van Houten has become general manager, M & C Div.

Three new vice presidents have been appointed at the **Le Roi Div., Westinghouse Air Brake Co.**; they are **R. H. Koehler,** from general sales manager to vice president, sales; **J. R. Gavigan,** from manager of administration and accounting to vice president, planning and administration; and **L. E. Dondero,** from manager of West Allis plant to vice president, manufacturing.

R. R. Schubert has been elected vice president of the **National Mine Service Co.** He will have headquarters in Greensburg, Pa., where he will continue his responsibilities in charge of the division which manufactures mine and industrial locomotives and related mining equipment.

Woods Hinrichs has been named manager of the newly-formed Exploration Services Department at **Fairchild Aerial Surveys Inc.,** and will be assisted by **William Kellogg** who will be chief geophysicist for the department. Fairchild Aerial Surveys Inc., is a wholly-owned subsidiary of **Fairchild Camera and Instrument Corp.**

Two major executive appointments for the **Marion Power Shovel Co., Division of Universal Marion Corp.** have been announced. They are the appointment of **Adrien F. Busick, Jr.,** formerly executive vice president and general manager, as president and general manager of the division, and **David Reich** as assistant to the president of Universal Marion Corp., in addition to continuing present duties as vice president-administration, Shovel division.

Busick, with Marion since 1929, includes among his several professional organizational affiliations, membership on the standards committee of the Power Crane and Shovel Association. Reich, with Marion since 1958, came to the company from the construction industry.

Four group vice presidents have been announced by **H. K. Porter Co., Inc.,** to take responsibility for various groupings of the company's diversified operations. **Fred W. Elliott** has been named to head divisions manufacturing friction and rubber products, refractories, and paint, as well as the company's Mexican operation; **James A. Drain** will direct the company's electrical divisions and Canadian operations; **Emmett H. Mann** will be responsible for the fabricated metal products divisions; and **B. Campbell Blake** will continue to operate the Connors Steel Division as well as assuming new duties in charge of the Vulcan-Kidd Steel Division.

Roger K. Warren has been appointed by **Flygt Corp.** as sales representative for lower Michigan, Indiana, Kentucky, Ohio and western New York for the company's line of electric submersible pumps. He will have his headquarters in Columbus, Ohio. He had previously been a sales engineer with Joy Mfg. Co., and with State Equipment Co.

CATALOGS & BULLETINS

CAR SHAKER. *Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.* Advantages of a 3½-ton car shaker for pushbutton unloading of granular material from open, hopper bottom gondola cars is given in leaflet 26B9438.

SCREW CONVEYORS AND FEEDERS. *Link-Belt Co., Dept. PR, Prudential Plaza, Chicago 1, Ill.* This subject is treated in a comprehensive manner by the company's Book 2989 which in 76 pages illustrates over 20 different types of screws, 14 types of troughs, with 4 types of covers, 5 types of discharge openings, and two types of feeders. Usage of both conveyors and feeders is described in a variety of situations and needs.

CONTROL PANEL DESIGN. *Fuller Co., Catasauqua, Pa.* The Fuller Fact File ER-G-8 is recommended by the manufacturer as a suitable guide to anyone considering the use of any type of production control panel to solve a materials handling problem. Topics discussed include strategic location, good electrical and mechanical practices, codes and standards to be kept in mind, enclosures of various types and safety precautions as well as some of the more common oversights in design. Also included is a list of organizations which publish codes and standards relating to control panel design.

CHAINS AND SPROCKETS. *Dodge Mfg. Co., Mishawaka, Ind.* Bulletin A691 describes a line of roller chain and Taper-Lock sprockets. Nearly all roller chain requirements can be met with the expanded

(*Continued on next page*)

(*continued from previous page*)

line which includes single strand, double strand, single strand heavy series double pitch drive, double pitch conveyor, double pitch conveyor with large rollers, and standard attachments. Photographs and diagrams show construction details of Taper-Lock sprockets. Steel plate and bore-to-size sprockets are also listed together with weld-on hubs and Taper-Lock bushings for special requirements. A section is devoted to Taper-Lock chain couplings. Complete with selection data and list prices. The bulletin also includes general information of roller chain drives, calculation of center distances, horsepower ratings, conveyor engineering, and instructions for lubrication and maintenance.

CENTRIFUGAL SEPARATOR. *Chemical Machinery Div., Baker Perkins Inc., 1000 Hess, Saginaw, Mich.* Cutaway views and specifications illustrate seven models of a centrifugal separator developed by Escher-Wyss of Switzerland and manufactured exclusively in the U. S. by Baker Perkins. This equipment is a multi-stage, push type device which handles several materials and is said to provide the user with a more thorough washing of the cake with minimum wash liquor.

MULTIPLE-TUBE COOLER. *Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.* Leaflet 22B9290 includes suggestions on how to save money five ways by using a multiple-tube cooler, which can be used in connection with a variety of industrial minerals, soft, fine, or granular.

PENDENT SWITCHES. *Joy Manufacturing Co., Electrical Products Div., 1201 Macklind Ave., St. Louis 10, Mo.* Nine rubber-encased pendent switches for electric hoist control are described in this bulletin, which includes a unique fold-back giving the reader a quick front, back and interior view of the station, showing the switch well, water seals and the micro-type positive switches in proper position. The principle features of these switches are said to be safety and minimum maintenance. Switches are available with two, four or six buttons, with one and two speed control and in a choice of snap-in aluminum legends.

MAGNET PULLEYS. *Stearns Magnetic Products, 635 S. 28th St., Milwaukee 46, Wis.* Bulletin No. 1022 provides information, including specifications, selection chart and technical background, on the company's new line of INDOX V permanent magnet pulleys which are available in a complete size range of from 12 to 48 in. in diam.

REPLACEMENT COILS. *General Electric Co., Schenectady 5, New York.* Bulletin GEA-7014 includes information and data on GE's Type MD replacement coils, which are manufactured to original equipment size and electrical design. Booklet suggests how to avoid problems of overheating and improper speed.

LIQUID LEVEL CONTROLS. *Charles F. Warrick Co., 1964 W. Eleven Mile Road, Berkley, Mich.* Warrick floatless electrode-type Liquid Level Controls are described in a new condensed catalog, which includes illustrations, diagrams, and charts.

SEMI-AUTOMATIC HOIST. *Vulcan Iron Works Co., 2960 S. Fox St., Englewood (Denver), Colo.* Booklet on use of semi-automatic hoists for raise driving cites such advantages as safety, increases in footage, and lower costs. Also mentioned: no bulkheads to go through, overhead cover available at all times, no overhead timbering and better ventilation. Included in bulletin is a complete description of procedures and specifications.

BELT CONVEYOR IDLER. *Hewitt-Robins, Inc., Stamford, Conn.* Bulletin 171, an engineering and product information booklet, includes details of construction, comparison of ten competitive designs, selection, procedure and examples, engineering tables, dimensions and specifications, on belt conveyor idlers. Basic types of idlers used in all types of service are covered.

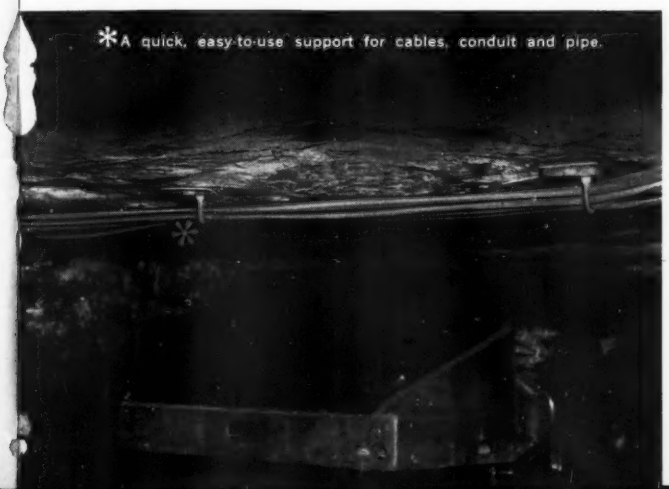
ENGINE TIPS. *Caterpillar Tractor Co., Advertising Div., Peoria, Ill.* Literature outlines steps that can be taken to minimize engine downtime and also stresses importance of using manufacturers' parts in order to be assured of maximum service life. Cylinder liners and piston rings and pins are among the items discussed in Form DE918 entitled, "Some Facts of Engine Life".

COST ESTIMATING GUIDE. *International Harvester Co., Consumer Relations Dept., 180 N. Michigan Ave., Chicago 1, Ill.* "Basic Estimating" is a comprehensive, 76-page book dealing with factors necessary for profitable earthmoving, forestry and pipelining operations.

Index to Advertisers

O-B Designs for Mining Men

RESULT:
Better working conditions for men and equipment



The O-B roof plate hook installs with one hammer blow.

- CLEARS MINE BOTTOM FAST AND EASY . . . cables, conduits and pipe go out of the way overhead leaving a clear way underneath for men and machines.
- PROTECTS ITS LINES FROM DAMAGE . . . saves costs because cables and other such valuable linage are held out of the way of wheels and feet.
- THESE HANDY HELPERS CAN BE USED OVER AND OVER AGAIN . . . once a section has been worked out . . . roof plate hooks can be reclaimed as easily as they were installed. This easy-to-use support moves with your operation! Order them from your O-B representative when he next stops at your mine. O-B Roof Plate hooks will make your mine operation safer and faster.

OHIO BRASS COMPANY, MANSFIELD, OHIO—Canadian Ohio Brass Company, Ltd., Niagara Falls, Ontario.

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EXPANSION SHELLS AND PLUGS • LINE MATERIALS • SAFETY AND CONTROL EQUIPMENT • ELECTRIC HAULAGE MATERIALS

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So much depends on unfailing light

Men and machines cannot work at peak productivity without proper illumination. Poor light means unsafe working conditions. Without light there is no work, no production underground. Illumination is *that* important.

Through years of close cooperation with the mining industry, Mine Safety Appliances has developed a quality line of illumination products that put all-important unfailing light underground. And, all MSA products are backed up by a network of sales, service and warehouse facilities.

MSA illumination products include miners' Edison electric cap lamps, permissible trip lamps and fluorescent mine lighting systems. Automatic lamp charging equipment is supplied for self-service lamphouse installations.

Contact your MSA representative for additional information. Or, write Mine Safety Appliances Company, 201 N. Braddock Ave., Pittsburgh 8, Pa. In Canada: Mine Safety Appliances Company of Canada Ltd., 500 MacPherson Ave., Toronto 4, Ont.